OUTLINES OF ANIMAL PHYSIOLOGY,

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DEPARTMENT OF SCIENCE,

BUCKNELL COLLEGE.

(COURSE II).

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Mr. Geo. G. Groff graduated at the West Chester State Normal School in its first class, in 1874. He was teacher of science here 1877-'79, since which time he has been Professor of Organic Sciences at Bucknell University.

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NOTE.

The Biological work at present (1895) offered in Bucknell University consists of the following courses: 1. Personal Hygiene. 2. Comparative and Human Physiology. 3. Systematic Botany. 4. Zoology. 5. Biology. 6. Human Osteology and Anatomy. 7. Comparative Anatomy. 8. Animal Embryology and Histology. 9. Plant Histology. 10. Sanitary Science.

Graduates of the University intending to study medicine, by pursuing all the above branches, will receive a certificate which will enable them to enter upon the second year's work in the best Medical Colleges.

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OUTLINES OF ANIMAL PHYSIOLOGY.

INTRODUCTORY LECTURE.

Definitions.—Science, Biology, Anatomy, Comparative Anatomy, Histology, Physiology, Pathology, Embryology, Hygiene, Sanitary Science.

The importance of Biological Studies.

The two worlds and three kingdoms in nature.

Characters of	**Inorganic and**	**Organic Bodies.**
1. Origin.	Action of chemical and physical forces.	Action of vital forces.
2. Composition.	Simple (H_2O, SiO_2, CO_2, etc.,).	Complex (C_{72} H_{112} N_{18} SO_{22})
3. Int. Structure.	Homogeneous.	Heterogeneous.
4. Size.	Indefinite.	Definite.
5. Shape.	Amorphous, or crystallized.	Regular and same for each species.
6. Surface.	Plane & straight lines.	Curved lines and faces
7. Growth and development.	By accretion.	By intussusception.
8. Offspring.	....	Like parents.
9. Duration.	Indefinite.	Definite.
10. Physical Basis.	Variable and simple.	Protoplasm (complex).
11. Decay.	Generally no marked tendency, and products variable.	Marked tendency to decay and products simpler than original.

References.—Martin's, Human Body, Chap. I. Orton's Comparative Zoölogy, Chap. I. Nicholson's Text-book of Zoölogy, Introduction.

LECTURE II.

Comparison of	**Plants and**	**Animals.**
1. Origin.	A living cell.	A living cell.
2. Composition.	Ternary compounds (C, O, H,) (Cellulose, chlorophyl).	Quaternary comp's (C, O, H, N,) (Proteid substances).
3. External form.	Regular, symmetrical. Up and down structures	Regular, symmetrical. (Fore and aft structures)
4. Internal structure.	Cellular.	Complex tissues.
5. Nourishment	Simple, and absorbed as found.	Complex, and prepared for absorption.
6. Development and growth.	Indefinite.	Definite and repair made.
7. Nervous system.	..................?	Always presents. (?)
8. Motion and locomotion.	Involuntary.	Voluntary.
9. Respiration.	Inhales CO_2. Exhales O.	Inhales O. Exhales CO_2.
10. Excreta.	Indefinite and complex	Constant and simple H_2O, CO_2, NH_3.

References.—Orton, Chaps. II and III. Nicholson's Text-book of Zoölogy, Introduction. Carpenter's Animal Phys. Chap. I.

LECTURE III.

The Chemical Composition of the Body.

The Elements found in the body.—O 72%, C 13%, H 9.1%, N 2.8%: Less than 1% P, Ca, Mg, Na, S; In minute quantities, K, Cl, F, Si, Fe, Mn, Li; Accidentally present, Pb, Cu, Ag, As.

Free Elements.—O, H, N.

Combined Elements.—Proximate principles.

1. *Inorganic Compounds*—H_2O=66% to 72% of human body, to 98% lower animals, (Teeth 02%, bones 22%, muscles 75%, blood 79%, saliva 99.5%)
   Phosphates of Ca, Mg, K, Na,
   Carbonates of Ca, K, Na,
   Chlorides and Sulphates of K and Na, HCl.

2. *Carbohydrates* (C, O, H, Amylaceous). Glycogen, glucose, lactose, inosit.
3. *Hydrocarbons* (C, O, H. Fats). Palmatin, stearin, olein.
4. *Acids.*—CO_2, lactic, acetic, butric, formic, sarco-lactic, etc.
5. *Nitrogenous.* (C, O, H, N, Albumenous). Albumens, albumenoids, proteids, peptones, fibrin, casein, myosin, ptyalin, pepsin, pancreatin; musine, collagen, chondrine, elastine, kreatine, gelatine.
6. *Coloring Matter.*—(C, O, H, N) The various pigments of the skin, blood, bile and urine. (Haemoglobin, biliverdine, bilirubin, urochrome)
7. *Crystalline Nitrogenous.* (Excrementitious). Urea, uric acid, hippuric acid, sodic glycocholate, sodic taurocholate.

References.—Martin, Chap. I. Dalton's Human Physiology, Chaps. I–II. Mill's Animal Physiology p. 135, and appendix.

LECTURE IV.

Life and Organization.

Nature of Life. Different theories. Definitions.

Manifestations of Life.—1. Spontaneous movements, growth and reproduction, maintaining a higher temperature, consciousness.

2. Contractility, irritability, conductivity, coördination, spontaneity, warmth, reproduction.

Conditions Necessary to manifestations of life.—Protoplasm, moisture, oxygen, warmth.

Definitions.—Undifferentiated tissues; anatomical elements; cells, tissues, membranes.

The Cell.—Parts, shapes, sizes, growth, multiplication.

Tissues.—Protective (epithelial); supporting (osseous and connective); storage (adipose); motor (muscular); nutritive; irritable, coördinating, conducting, automatic, (nervous); reproductive.

Membranes.—Basement, mucus, serous, synovial.

Organs.—Glands; apparatus, system, functions, (animal and vegetable functions.)

References.—Martin, Chap. II and III. Orton, Chap. IV and V. Mills p. 8. Gray's Anatomy, Introduction.

LECTURE V.

Classification of the Animal Kingdom.

Why any classification is needed.

The Central Ideas in classification are structure, physiology, and embryology.

Aristotle's System.—

Eneima=vertebrates.
Anaima=invertebrates.

Von Baer's Types.—

1. Peripherie (Radiate). 3. Longitudinal (articulate).
2. Massive (Mollusca). 4. Double Symmetrical (Vertebrate).

Lamarcks' Groups.—

1. Apathetic. 2. Sensative. 3. Intelligent.

Linnaeu's System.—

1. Vermes. 2. Insecta. 3. Pisces. 4. Amphibia. 5. Reptilia. 6. Aves. 7. Mammalia.

Cuvier's System.—

(1. Protozoa). 2. Radiata. 3. Articulata. 4. Mollusca. 5. Vertebrata.

Later Systems.—

Man's Zoological Position.—

References.—Orton, chap. XXI. Nicholson's Text-book of Zoölogy. Introduction. Mills pp. 33–40.

LECTURE VI.

The Supporting Tissues.

Connective Tissue.—Nature, distribution, use.

The Skeleton.—Exo-Skeletons, endo-skeletons, splanchno-skeletons, axial, apendicular, and connective skeletons; natural and artificial skeletons.

The Bones.—Number, shapes; proximal and distal, anterior and posterior, dorsal and ventral parts.

Surfaces.—Periosteum, shape, head, neck, tuberosities, trochanters, spines, condyles, crests, fossae, foraminae.

General Structure.—Shaft, ends, displöe, marrow.

Histology.—Haversian canals, lacunae, canaliculae, corpuscles.

Composition.—It varies, gelatine, mineral matter.

Growth of Bone.—Development, ossification.

Repair.—How bone is repaired when broken.

Uses of Bone.—Support, protection, act as levers.

Cartilage.—Temporary and permanent, structure, properties, distribution, uses.

Ligaments.—White and yellow; structure, properties, uses.

References.—Martin, Chap. VII. Orton, pp. 36–37. Gray's Anatomy.

LECTURE VII.

General Description of Human Skeleton.

References.—Martin, Chap. VI–VIII. Gray's Human Anatomy.

LECTURE VIII.

Articulations and Joints.

Parts of a True Joint.—Bone, cartilage, ligaments, synovial membrane, synovia, bursae.

Classification
- Imperfect
  - Sutures of head.
  - Symphyses of face and pelvis.
  - Spinal column.
- Perfect
  - Sliding joints of wrists and ankles.
  - Hinge.
  - Ball and Socket.
  - Pivot.

Movements of Joints.—Yielding, sliding; flexion and extension; abduction and adduction; rotation and circumduction.

———o———

Peculiarities in human skeleton.

Design in human Skeleton.

Hygiene of osseous system.

Diseases of osseous system.—Rachitis, caries, spinal curvature, sprains, dislocations, anchylosis, felons, broken bones, injured joints.

References.—Martin, Chap. VII. Gray.

LECTURE IX.

The Development of the Skeleton.

1. **No Skeleton at All.**
2. **The Cell Wall.**
3. **Scattered Spiculae.**—
   Illustations, starfish, sponges, etc.
4. **The Exo-Skeleton.**—
   Chitinous, in lobsters and insects.
   Silicious, in some sponges and protozoa.
   Calcareous (sclerodermic and sclerobasic in corals).
5. **Endo.Skeletons.**—
   (1). The noto-cord, in amphioxus.
   (2). The cartilaginous, in fish.
   (3). The bony skeletons in amphibia, reptilia, aves, and mammalia.

References.—Orton, Chap. XVI. The Bones and Teeth, Owen.

LECTURE X.

The Muscular System.

Muscles Defined.—

The Two Classes of muscles. Mixed muscles.

Number of distinct muscles.

Parts of a muscle.—Tendons (2), belly, fascia, aponeurosis, perimesium, fasciculi.

Histology.—Sarcolemma, fibers, fibrillae, striae of voluntary fibers.

Properties.—Contractility, irritability, elasticity, tonicity, (rigor mortis).

Parts of the Skeleton.—Bones, cartilage, ligaments.

Uses.—Primary use to produce motion. Secondary uses, to protect, and give symmetry and beauty to body.

Shapes.—Long, broad, radiate, pinniform, bipinniform, biceps, circular (sphincter).

Name.—From position (fronto-occipital); shape, (deltoid, digastric, polygastric, rectus), and action, as pronators, rotators, flexors, extensors, etc.

Arrangement.—Skeletal in pairs, circular and radiate. Visceral muscles.

Composition.—Water 75%, mineral salts, myosin, syntonin; reaction at rest, alkaline, in action, acid.

Development.—From cells to fibrillae, then fibers, and fasciculi.

Classification.—1. Skeletal (voluntary, striated, red, vertebrate). 3. Visceral (involuntary, smooth or plain, pink, invertebrate).

Comparison of the	**Skeletal** and	**Visceral Muscles.**
Color	reddish	pinkish.
Action	voluntary, rapid,	involuntary, slow.
Filaments	striated	smooth.
Attachment	to bones	free from bones.
Structure	solid	hollow.
Fibers	parallel	interlaced.

Hygiene.—Exercise needed for health of muscles.

Diseases.—Myalgia, cramp, back-ache, pimple, boil, carbuncle, abcess, felon.

References.—Martin, Chaps. IX, X. Mills p 167–210.

LECTURE XI.

The Mechanism of the Body Movements.

Amoeboid Movements.—

Ciliary Movements.—Voluntary and involuntary.

Muscular Stimuli.—Mechanical, chemical, electrical, nervous.

Changes During Contractions.—In form, density, temperature, chemical, electrical, sounds produced.

Rapidity of Muscular Movements.—Respiration, heart, vocal cords, insect wings. (Note 83 Orton. Ordinary 80–1024 per Sec. Greatest 198 to 2172 mentioned by Mozart at Parma 1770).

Nervous Control.—

Energy of Muscular Action.—Source of muscular power. Energy varies with long and short fibers, 50 to 100 lbs. to square inch. Grit.

The Education of Muscles.—

The Muscles of Expression.—

The Muscular Sense.—

References.—Martin, Chap. XI. Orton, Chap. XVII.

LECTURE XII.

Motion and Locomotion.

Attachment of Muscles to Bones.—Origin and insertion.

The Bones Levers.—Bones and muscles form automatic machines. Classes of levers; advantages and disadvantages of each class.

How Man Stands, walks, runs, leaps, swims.

Digitigrade, plantigrade, pinnigrade locomotion.

Comparative Study of Locomotion Walking.—By man, (2) quadrupeds (4), insects (6), spiders (8), lobsters (10), centipeds (20), milipeds (20+).

Swimming.—By cilia, by tail, fins; serpents, aquatic birds, mammals, man, squids, etc.

Flying.—Insects, birds, bats, squirrels, lizards, fish.

Referencee.—Martin, Chap. XI. Orton, Chap. XVII. Carpenter Comparative Physiology.

LECTURE XIII.

The Tegumentary System. (The Skin.)

General Structure.—Epidermis, dermis, malphigian layer, papillae, pores, connective tissue, blood vessels, nerves, muscles, glands.

Total Surface.—In man about 16 sq. feet.

Thickness.—From 1-12 to 1-100 of inch.

Pigmentry Matter.—Complexions, effect of sun on, albinos.

Mucus Membranes,—Structure, distribution.

Development and Repair.—Manner of growth, desquamation, scar tissue.

Glands of the Skin.—1. Sebaceous; structure, distribution, function. 2. Perspiratory; structure, distribution, function; nature, amount, and uses of the perspiration; nervous control of same.

Functions of Skin and Mucus Membranes.—Protecting, exhaling, absorbing, secreting, heat-regulating, touch.

Hygiene of the Skin.—Bathing.

Diseases of the Skin.—Warts, corns, moles, birthmarks, fever-sores, tetter, chilblain, itch, ringworm, pimples, scars, ingrowing nails, blackheads.

References.—Martin, Page 412–422. Orton XVI. Dalton (see index). Mills p 412–451. Carpenter's Comparative Physiology.

LECTURE XIV.

Appendages of the skin.

Hair.—Structure, distribution, development, uses. Causes of baldness and grayness. Hygiene of hair.

Wool.—Bristles, feathers, scales.

Nails.—Structure, development, uses, hygiene.

Hoofs.—Claws, horn.

Teeth.—(Discussed under alimentary canal).

References.—Orton, Chap. XVI. Owen's Bones and Teeth. Carpenter's Comp. Phys.

LECTURE XV.

The Nervous System. (Anatomy).

The Nervous System Defined.—Its general structure and object; histology of white and gray matter.

The Encephalon.—Dura mater, pia mater, arachnoid; weight of brain, relative and absolute; cerbrum, cerebellum, pons, and medulla.

The Cerebrum.—Hemispheres, lobes, convulutions, sulci; position of white and gray matter, ventricles, ganglia, corpora striata, optic thalami, corpora quadrigemini. pineal gland, olfactory lobes, crura.

Pituitary body.

Cerebellum.—Location, protection, size weight, surface, interior.

Medulla Oblongata.—Location, size, surface, interior, nerves arising from.

Pons Varoli.—Location, structure, nerves.

References.—Martin, Chap. XII. Dalton. Mills. Gray's Anatomy.

LECTURE XVI.

The Nervous System. (Anatomy).

The Spinal Cord.—Location, protection, length, divisions, histology.

The Cranial Nerves, (12)—Number, names, distributionand uses of each. Deep and superficial origins; ganglia and plexuses.

The Spinal Nerves, (31)—Origin, roots, ganglia; plexuses (cervical 8, dorsal 12, lumbar 6, sacral 5, coccygeal 1,) nerve trunks, course of afferent and motor nerves.

Sympathetic Nerves.—Why so called. Their distribution, ganglia, plexuses.

Sporadic Gauglia.—

References.—Martin, Chap. XII. Dalton. Mills. Gray's Anatomy.

TABLE OF THE PRINCIPAL CRANIAL NERVES.

Name.	Origin.	Distribution.	Function.
1. Olfactory.	Olfactory lobes.	Schniderian membrane of nose.	Special sense of smell.
2. Optic.	Optic thalami, corpora quadrigemina.	Retina of eye.	Special sense of sight.
3. Motor occuli.	Valve Vieussens.	To motor muscles of eye-brows, lids and motor muscles of eye.	Motion.
4. Patheticus or Trochlearis.	Valve Vieussens.	Superior oblique muscles of eye.	Motion.
5. Trifacial.	Pons Varolii.	All parts of face, superficial and deep.	Sensation. Taste.
6. Abducens.	Pons and Medulla	To Ext. rectus of eye.	Motion.
7. Facial.	Medulla.	To muscles of face.	Motion.
8. Auditory.	Medulla.	To internal ear.	Hearing.
9. Glosso-Phanyngeal.	Medulla.	Base of tongue, pharynx, glottis.	Taste and motion.
10. Pneumogastric or Par vagum.	Medulla.	Glottis, heart, lungs, and viscera.	Controls respiration and circulation.
11. Spinal Accessory.	Spinal cord.	To muscles of neck and throat.	Motion.
12. Hypoglossal or lingual.	Medulla, spinal cord.	To tongue.	Motion to tongue.

LECTURE XVII.

The Nervous System. (Physiology).

Nerve force.—What is it? How generated and propagated? Relation to other forces. Nerve stimuli. Points of application.

Nerve cells, functions of.—To originate nerve force. To coördinate nerve force. To register impressions.

Functions of nerve fibers.—

Functions of ganglia.—

Cerebrum.—Localization of functions. Ferrier's experiments, Seat of language, of pain, of motor impulses. Basal ganglia.

Cerebellum.—

Medulla oblongata.—

Pons Varoli.—

Spinal cord.—1. Transmission. 2. An independent nerve centre.

Functions of nerves.—1. Afferent nerves,—(sensory, reflex, excito-motor, inhibitory).

281004

Sympathetic nerves.—Control many muscular movements, special sense organs, circulatory and respiratory organs. Reflex actions.

Reflex Action.—Natural and acquired.

Specific Energies of nerves.—

References.—Martin, Chap. XIII. Dalton. Mills.

LECTURE XVIII.

The Nervous System. (**Hygiene**).

Conditions necessary to healthful development.

Conditions necessary to maintain in healthful state.

General Effects of stimulants and narcotic drugs upon.

Physical causes of insanity.

Diseases.—Paraplegia, hemiplegia, paralysis, paresis, lock-jaw, convulsions, hysteria, epilepsy, chorea, locomotor ataxia, neuralgia, delcrium, hydrocephalus, softening of brain, nervous exhaustion, vertigo, "Rush of blood to head."

References.—The Building of a Brain, Clark. Work and Over-work, Wood.

LECTURE XIX.

The Nervous System. (**Development of**).

1. **Undifferentiated.**—Ill. Protozoa.
2. **Nervo-muscular cells.**—Ill. Hydra.
3. **First system** of ganglia and fibres.—Ill. Jelly-fish.
4. **Radiate type.**—Ill. Star-fish.
5. **Longitudinal type.**—Ill. Worms, insects and crustaceans.
6. **Cerebro-spinal type.**—
    1. Dorsal cord. Ill. Lanceolet.
    2. Parts all horizontal, no ganglia overlapping, no convolutions, sympathetic system present. Ill. Reptiles.
    3. Ganglia begin to overlap, convolutions begin to appear, sympathetic system present, no corpus striatum. Ill. Birds.

4. Cerebral ganglia and cord at right angles. Cerebral ganglia overlap olfactory-lobes and cerebellum; corpus striatum and sympathetic system present.

Progress in Cephalization.

References.—Orton, Chap. XVIII. Carpenter's Comp. Phys.

LECTURE XX.

Nutrition.

1. **Foods.** 2. **The Organs.** 3. **The Processes.**

Foods.—Food defined, why needed, source of all organic foods. Source of potential energy in foods, how obtained, how liberated. The destination of all food.

Hunger and Thirst.—Where located; appetite, natural and artificial. Its value.

Classification of foods.—1. Inorganic and organic. 2. Solid, liquid and gaseous. 3. Animal and vegetable. 4. Nutritious and respiratory. Chemical classification.

Classes.	**Illustrations.**	**Uses.**	**Form in which leave the body.**
I. Inorganic	Air (O). Water. Mineral Salts.	Promote chemical changes and nourish the body.	CO_2, H_2O. H_2O. As they enter body.
II. **Saccharine** C, O, H,	Starches. Sugars. Gums.	Force. Heat Nutrition.	Reduced to H_2O & CO_2.
III. **Oleaginous** C, O, H,	Fats and Oils.	Heat. Force. Nutrition.	Reduced to H_2O & CO_2.

IV. **Nitrogenous** C, O, H, N,	Musculin. Fibrin. Casein. Gluten. Albumen. Legumin.	Nutrition. Heat. Force.	Reduced to H_2O, CO_2, Urea.
V. **Auxiliary**	*Condiments.* Vinegar, pepper, spices, mustard, etc.	Excite to activity internal organs.	Reduced to simpler forms.
	Stimulants. Tea, coffee, alcohol, tobacco, etc.	Stimulate depress, obstruct.	Reduced to simpler forms.

References.—Martin, Chap. XX. Orton, Chap. VII. Mills, p. 290. Dalton.

LECTURE XXI.

Foods.

Essentials in Food.—Necessary chemical elements, solubility, assimilability.

Animal Foods.—Value and characters of beef, mutton, veal, pork, poultry, fish, eggs, milk, butter, cheese.

Diseased Meats.—Tainted meats, salted meats. Excessive use of meats.

Cereals.—Wheat, rye, oats, barley, millet, buckwheat, Indian corn, rice, beans, and peas.

Succulent Vegetables.—Potatoes, sweet potatoes, tomato, turnip, parsnips, asparagus, onion, cabbage, lettuce, celery, cress, melons, cucumber, mushroom.

Fruits.—Constituents, nutrition, value. How best eaten. Preservation of.

References.—Park's Text-book of Hygiene.

LECTURE XXII.

The Organs of Nutrition. (General View).

Hands and Brain.—

Alimentary canal.—1. Lips. 2. Jaws and Teeth. 3. Mouth and Tongue. 4. Fauces. 5. Pharynx. 6. Oesophagus. 7. Stomach. 8. Pyloris. 9. Duodenum. 10. Jejunum. 11. Ileum. 12. Caecum. 13. Colon. 14. Rectum. 15. Anus.

The peritoneum, the omentum and the mesentery.

Accessory Organs.—Salivary glands, liver, pancreas, spleen, kidneys.

References.—Gray's Human Anatomy. Martin, Chap. XXI. Orton, Chap. VIII. Dalton, Chap. VIII.

LECTURE XXIII.

The Teeth.

The development of teeth from skin.

Parts of mammalian tooth.—Crown, neck, fang, alveolus.

Structure. Enamel, cement, dentine, pulp.

Histology.—

Order of development.—Deciduous. Permanent teeth.

Classification of teeth.—Incisors, canine, premolar, molar, wisdom.

Dental formulae.—

Man's. $i\,\frac{2-2}{2-2}$, $c\,\frac{1-1}{1-1}$, $pm\,\frac{2-2}{2-2}$, $m\,\frac{3-3}{3-3}=32$.

Hog's, $i\,\frac{3-3}{3-3}$, $c\,\frac{1-1}{1-1}$, $pm\,\frac{4-4}{4-4}$, $m\,\frac{3-3}{3-3}=44$.

Comparative study.—1. No teeth at all.

2. First teeth in sea urchin. (In snails).
3. True teeth in fish; shape, location, use.
4. In reptiles; location, shape, uses; fangs.
5. Mammalian teeth. Narwhal=1. Dolphins 180–220. Elephant, man, hog.

6. Teeth in herbivora, carnivora, omnivora, ruminants.
7. Uses of Teeth.

References.—Martin, Chap. XXI. Orton, Chap. VIII. Owen. Bones and Teeth.

LECTURE XXIV.

Comparative Anatomy of Alimentary Canal.

1. **None at all.**—Nutrition taken through skin. Ill. protozoa and intestinal parasites.

2. **Extemporized stomachs.**—Many protozoa.

3. **Digestive tract and body cavity** one. Ill. hydrozoa.

4. **Digestive tract** consists of mouth and gullet, no vent. Ill. corals.

5. **Simple digestive tube** plus vent, starfish.

6. =**5**+ **sac-like follicles,** as in leech.

7. =**6**+ **masticatory organs.** Ill. sea urchin.

8. =**7**+ **stomach, liver,** salivary glands and kidneys. Ill. many articulates.

9. =8+ **large and small intestine,** also villi. Ill. some insects.

10. **In Fish.**—Simple, short, wide, straight; liver, pancreas, kidneys.

11. **Reptilia.**—Amphibians, much like fish.
Crocodilia, much like birds, mesentery.

12. **Birds.**—Crop, proventriculus, gizzard, intestine, cloaca.

13. **Mammalia.**—Lips, pharynx, gullet, stomach (in Ruminants, rumen, reticulum, psalterium abomassum), large and small intestine.

References.—See Carpenter's Comp. Physiology.

LECTURE XXV.

The Processes of Nutrition. (Metabolism).

Metabolism includes prehension, (cooking), mastication, insalivation, deglutition, stomach digestion, intestinal digestion, absorption, sanguification, circulation, oxygenation (or respiration), assimilation, secretion, heat production, disassimilation, excretion.

Prehension.—In man, in infant. Comparative study of.

Preparation of food.—Cleansing, cooking.

Mastication.—Organs, process, purpose of. Comparative study of.

Insalivation.—Saliva, its sources, character, composition, amount; uses, lubrication, chemical, aerates food, develops taste; nervous control over. In infants. Comparative study.

Deglutition.—The process, nervous control of. Vomiting. Swallowing of air.

Stomach digestion.—Location and structure of stomach; source, amount, composition and uses of gastric juices, Pepsin, peptones, chyme, stomach movements. Nerves of stomach. Post-mortem digestion of stomach.

Diseases.—Ulcerations of alimentary canal. Typhoid fever, cholera, diarrhoeas, dyspepsia, dysentery, intestinal parasites, cancer. Inflammation of bowels.

References.—Martin, Chap. XXIII. Orton, Chap. VIII. Dalton, Chap. VIII. Mills, p. 290–308.

LECTURE XXVI.

Intestinal Digestion.

Fluids.—Sources, action, chyle.

The Liver.—Location, anatomy, histology; bile, amount, composition, uses.

The Pancreas.—Location, anatomy, fluid produced, properties, uses.

The Intestine.—Glands, (Peyer's, Lieberkhun's, Brunner's.). Properties and uses of intestinal juice.

Use of each digestive fluid.

Absorption.—Definition. 1. Into veins. 2. Into lacteals; villi, valvulae conniventes.

Sanguification.—Definition, where accomplished.

References.—Martin, Chaps. XXI, XXIII.

LECTURE XXVII.

The Circulation.

Analysis.—1. The Fluids. 2. The Organs. 3. The Forces. 4. The Courses. 5. The changes in the blood. 6. Nervous control. 7. Diseases of organs.

1. **The chyle.**—Source, characters, destination.

2. **The blood.**—Ideas of ancients concerning blood, sources of, amount, characters, (color, odor, taste, sp. gr., temperature, reaction), composition, structure, coagulation, crystals.

Uses of blood.—

Transfusion of blood.—

Theories of fibrin formation.—

Medico—legal examinations of blood.

Living Blood	Plasma 900	Water.	Serum	Coagulated Blood.
		Salts.		
		Fats.		
		Albumens.		
		Gases.		
		Fibrin.		
	Solids 100	Red corpuscles.	Clot	
		White "		
		Pigments.		

3. **Lymph.**—Source, characters, destination.

References.—Martin, Chaps. 4, 5, Orton, Chap. 12.

LECTURE XXVIII.

The Organs of Circulation.

The Heart.—Position, size, shape, pericardium, cardiac vessels.

Cavities.—auricles, ventricles, valves, columnae carnae, chordae tendinae.

Heart's action. – Frequency of beat, systole, diastole, sounds, vitality of heart.

Work done by heart.—

Ideas of ancients concerning heart.

Arteries.—Position, structure, characters. The pulse.

The Capillaries.—Position, distribution, size, structure.

The Veins.—Position, distribution, structure, characters, capacity, anastomoses.

The Lymphatics.—Position, distribution, structure. Thoracic duct, receptaculum, lymphatic glands.

Comparison of Arteries	**and Veins.**
Arise in heart,	Terminate in heart.
Walls thick.	Walls thin.
Walls elastic.	Walls inelastic.
No valves.	Valves numerous.
Course straight.	Course tortuous.
Deep in tissues.	Superficial and deep.
Carry scarlet blood.	Carry dark blood.
Bleed in scarlet jets.	Bleed in steady streams.
Empty in dead body.	Full in dead body.
When empty, stand open.	When empty, walls collapse.
Branch dichotomously.	Branch irregularity.

References.—Martin, Chap. 14.

LECTURE XXIX.

The Forces of Circulation.

I. **Accelerating Forces.**—

1. Hearts' contractile power.
2. Hearts' suction power.
3. Aspiration
4. Muscular contraction.
5. Arterial elasticity.
6. Venous contractility.
7. Capillary attraction. Capilliary absorption.
8. Diffusion and cell absorption.
9. Differences of temperature.
10. Gravitation.

II. **Retarding Forces.**—
  1. Friction.
  2. Gravitation.
  3. External pressure.

Control of Nervous system over circulation. Automatic rhythmic action of heart.

Blushing, palor, fainting.

References.—Martin, Chap. 15, 16 and 17.

LECTURE XXX.

The Course of the Circulation.

History of the Discovery of circulation.

The Pulmonic circulation.

The Systemic circulation.

The Portal circulation.

The Cardiac circulation.

The Sympathic circulation. Lacteals. Forces.

Proofs that the blood actually circulates.—1. Obs. on lower animals. 2. Chemicals injected in artery appear in veins. 3. Valves of heart permit fluids to go one way only. 4. The bleeding of cut artery shows it. 5. An empty vein fills from capillaries. 6. When an arm is tightly bandaged, it is shown.

Rapidity of circulation.—In arteries, capillaries, veins. Time required for the blood to pass through heart.

Foetal Circulation,

References.—Martin, Chap. XIV.

LECTURE XXXI.

Changes in the Blood During its Circulation.

Changes in color and composition. Losses and gains.

Changes occur in capillaries, in glands, in lymphatics.

Changes occur in blood current. Corpuscles.

How **O** and CO_2 are carried in blood.

Sources of Loss to blood.—Lungs, kidneys, skin, alimentary canal, secreting and excreting glands, all proeesses of assimilation, heat from all free surfaces.

Sources of gain to blood.—All absorbed food, oxygen, water, all products of disassimilation, all products from ductless glands, heat from chemical changes and from friction.

References.—Martin, Chap. 15, 16, 17.

LECTURE XXXII.

Hygiene and Diseases of Circulatory System.

Hygiene.—Pure food, pure air and pure water, give pure blood. Pure blood, sound health.

Diseases of blood.—Plethora, anaemia, chlorosis, uraemia, albumenuria, rheumatism. diphtheria, diabetes, "blood poisoning", "malaria," fevers.

Diseases of Heart.—Dropsy, organic disease, rheumatism. Use of chloroform prohibited. How one with heart disease should live.

Diseases of Arteries.—Calcification, weakness in old age. Wounded arteries.

Diseases of Veins.—Enlargement in legs, hemorrhoids. External pressure on vessels of blood, neek, chest, waist, legs, feet.

Capillaries.—Haemorrhages from lungs, nose, other mucus membranes, Haemorrhagic diathesis. Bruises.

LECTURE XXXIII.

Comparative study of Circulation.

1. **No vessels of any kind.**—Chyle circulates by osmosis.
2. **Contractile vescicle** (heart) appears in Amoeba.
3. **Tubes radiate** from stomach to circulate chyle. Ill. Starfish.
4. **First distinct** circulatory vessels. Ill. Starfish.
5. **Dorsal tubes** (thoracic duct).—Ill. Articulates.
6. **Dosal tube + heart.**—Ill. Lobster.

7. **Dorsal tube** + **ventral tube** + connecting vessels. Ill. articulates and molluscs.

8. **Double heart** of molluscs.

9. **Double heart** of fish.

10. **Triple heart** of Reptilia.

11. **Mammalian heart.**—

Warm and cold blooded animals.

Corpuscular and non-corpuscular blood.

Nucleated and non-nucleated corpuscles.

References.—Orton, Chap. 13. Martian 17. Carpenter Comp. Phys.

TABLE OF PRINCIPAL ARTERIES.

TO HEAD.

Names.	**Distribution.**	**Location.**
Int. carotid 2.	Supply brain.	Deep seated.
Vertebral 2.	Supply brain.	Deep seated.
Opthalmic 2	Supply eye.	Deep seated.
Ext. cartoid 2.	Lingual.	Tongue.
	Facial.	Lower face.
	Temporal.	Upper face & scalp.
	To Trunk.	
The aorta 1.	To all parts of body.	Chest and abdomen.
Coronary 2.	Walls of heart.	Walls of heart.
Pulmonary 2.	To lungs.	Bet. aorta & lungs.
Phrenic 1.	To diaphragm.	Bet. aorta & diaphragm.
Intercostals.	To chest walls.	Chest walls.
Gastric 1.	To walls of stomach.	
Hepatic 1.	To liver.	
Splenic 1.	To spleen.	
Renal 2.	To kidneys.	
Mesenteric 1.	To mesentry.	
Spinal 1.	To spinal cord.	

The Upper Extremities.

Axillary 2.	To shoulders.	In axilla.
Brachial 2.	To arm.	Inner side of arm.
Radial 2.	To forearm and fingers.	Radial forearm.
Ulnar 2.	To forearm and fingers.	Ulnar forearm.
Palmar 2.	To palms.	To palms.

Lower Extremities.

Femoral 2.	Hip and Thigh.	Inner thigh.
Popliteal 2.	Leg, ulnar side.	Ulnar side leg & foot.
Tibial 2.	Leg, tibial side.	Tibial leg.
Peroneal 2.	Posterior leg.	Posterior part of leg.

LECTURE XXXIV.

Respiration.

Respiration defined.—Its object. External and internal respiration.

Indirect respiration.—

1. Through skin.
2. Through water vascular system.
3. Through gills.

Direct respiration.—

1. Through skin.
2. Through tracheae.
3. Through lungs.

The Structure of Lungs in fish, turtles, snakes, mammals.

Respiratory movements in reptiles, birds and mammals.

Modified Respiratory movements.—

To express emotions,—voice, sighing, sobbing, crying, laughing.

To expel foreign bodies,—coughing, sneezing, expectorating, etc.

Unclassified,—yawning, gaping, snoring, hiccough.

Reference.—Orton, chap. XXIV. Carpenter's Animal Phys.

LECTURE XXXV.

Respiration (Continued).

The Organs of Respiration.—The nares, passages of head, pharynx, glottis, epiglottis, larynx, trachea, bronchii, bronchial tubes, bronchioles, cells.

The Lungs.—Location, pleura, lobes, lobules, cells, bloodvessels, nerves.

Capacity of the lungs.—1 gal. or 230 inches. "Vital capacity" increases 9 inches for each 1 inch in heighth above. Tidal air 30 in. Stationary air 130 in. Complemental, supplemental and residual air.

Work done by lungs in one day.—400 cu. ft. air received, 2 litres blood exposed to air 10,000 times, 2 lbs Oxygen gained, 2 lbs CO_2 and 9 oz water lost every 24 hours.

The Air.—Composition. Purity mantained in nature by sunlight, differences of temperature, diffusion, and plants.

References.—Martin, Chap. XXIV, XXV.

LECTURE XXXVI.

Respiration (Continued).

Respiratory Movements.—

Mechanism of inspiration and expiration.
Superior costal, inf. costal and abdominal resp.
Facial respiration. Forced respiration.
Movements of glottis and epiglottis in respiration.
Frequency of inspiration. Respiratory sounds.
Eupnoea, dyspnoea, apnoea.

Nervous control of Respiration.—Respiratory centre. Stimuli. Action rythmical.

Changes in Air during respiration.—Volume, temperature, composition.

Changes in blood during respiration.—Color, composition, temperature.

Hygiene.—Breathe pure air, *through nose*, avoid dust and germs, expand chest systematically, fully expand lungs.

Diseases.—Colds, catarrhs; croup, sore throat, quinsey; whooping cough, bronchitis, pleurisy, pneumonia, asthma, consumption, pulmonary hemorrhages, asphyxia.

References.—Martin, Chap. XXV.

LECTURE XXXVII.

Assimilation and Secretion. (Metabolism.)

Definition.—Occurs in blood and body cells.

Occurs from capillaries and lymphatics.

Assimilation of fat.

Assimilation of internal secretions.

Do all foods nourish body?

What becomes of any excess of food eaten?

Secretion defined.—Classification of secretions.

Anatomy of glands.

Physiology of secretion.

References.—Martin, Chap. XVIII. Mills.

LECTURE XXXVIII.

Animal Heat.

Heat in living plants.—

Cold and warm blooded animals, birds.

Variations in heat of body.—Climatic, local, diurnal. In childhood and old age. Extreme Variations. Frozen animals.

Production of animal heat.—By all the processes of nutrition. By every chemical change in the body. In starving animals, in those fattening. Respiration and heat production. Alcohol and heat. Motion of blood, muscles, cilia, nervous action and electrical currents of body.

Distribution and regulation of heat.

Amount of heat daily produced in man.

Heat lost.—By radiation, warming excreta, contact with cold air, evaporation of cutaneous and pulmonic perspiration, by work done.

Maintainance and regulation of heat.—By clothing, exercise, closure of pores of skin, food supply.

Nervous control of heat production.

Power or the body to resist extremes of heat and cold. In young and aged. Frost bitten.

References.—Martin, Chap. XXIX.

LECTURE XXXIX.

Disassimilation and Excretion.

Disassimilation defined.—Where does it occur? Is it by one step, or by many?

By one step $C_2H_6O+6O=2\ CO_2+3\ H_2O$.

but $C_2H_6O+O=C_2H_4O+H_2O$.

$C_2H_4O+O=C_2H_4O_2$.

$C_2H_4O_2+4O=2\ CO_2+2H_2O$.

The history of the formation of urea.

Excretion defined.—The organs. Kidneys, skin, lungs, intestines. General structure of these organs.

Composition of excreta from different organs.

Daily losses from each set of organs.

Vicarious action of different excretory organs.

Importance of processes of excretion.

Diseases.—Constipation, hemorhoids, fistula, colic, diarrhoeas, dysentery, cholera, cholera-morbus, peritonitis, typhoid fever, dyspepsia, Bright's disease.

References.—Martin, Chaps. 18. 19, 27, 28.

LECTURE XI.

Sensation and the Senses.

DEFINITIONS.—

1. **Irritibility.**—Power in a tissue to respond to a stimulus.

2. **Impression.**—Effect on extenal nerve terminations produced by any stimulus.

3. **Impulse.**—The effect of an impression transmitted along a nerve.

4. **Sensation.**—The effect produced on nerve cells by nervous impulses.

    1. **Neurosis.**—Unconcious sensation.

    2. **Psychosis.**—Concious sensation.

5. **Conciousness.**—The knowledge of activity in ones mind.

6. **Perception.**—The reference of a sensation to the object producing it.

7. **Conception.**—The formation in the mind of ideas.

8. **Idea.**—The image formed in the mind, the immediate object of a perception.

9. **Judgment.**—The comparison of ideas.

If the nerve of smell is in good working order, it is *irritable*, and the odor from a rose produces an *impression* on its external termination; this impression, as an *impulse* travels to the brain, and produces if I am asleep, a *neurosis*, but if awake a psychosis, and I have *conciousness*, of a pleasant odor; this referred to roses gives a *perception*, referred to the particular rose, a *conception; ideas*, and *judgments* follow when compared with other odors.

Sensations differ in modality, quality and intensity.

Essential structure of a sense organ.

Why are sensations different in modality:

1. It is not in stimulus.
2. Not in the nerve.
3. Not in the ext. organ.
4. It is in the central termination.

Objective sensations all referred to exterior.

What sensations really tell us. Page 473 Martin.

What is the "personal error?"

What is unconcious cerebration?

What are sensory illusions?

References.—Martin, Chap. XXX. Huxley and Youmans' Physiology.

LECTURE XLI.

Sensations Classified.

Subjective and Objective.

General sensibilities. (Common sensations). All feelings, pleasant, unpleasant, pain, titilation, suffocation, nausea, satiety, weariness, restlessness, appetite, thirst, etc.

2. **Intermediate,**—temperature, weight, pressure, muscular sense.

3. **Special,**—touch, taste, smell, hearing, sight.

Touch.

Definition.—The organs of touch (fingers, ears, tongue, trunk, nose, lips, antennae, tentacles).

The nerve termination.

Physical condition of objects touched.

Delicacy and acuteness of touch.

Use of touch,—its education, reliability, deception.

References.—Martin, Chap. XXX.

LECTURE XLII.

Taste and Smell.

Taste defined.—

The organ; papillae, glands, nerves.

Physical condition of substances tasted.

The uses of taste, acuteness, cultivation.

Complex nature of taste sensations; deception of taste.

Smell.

Definition.—

Organ, location, nerve.

Physical condition of substances smelled.

Use.—Not all poisonous gases detected.

Acuteness.—Most refined of all senses, (for those things which it can detect. In lower animals, in wild men.

Cultivation.—

Effect of cold in head.—

References.—Martin, Chap. XXXIV.

LECTURE XLIII.

Sight.

Definition.—The sense, through which, by the agency of light, external objects are perceived.

Nature and properties of light.

Theories as to the nature of light.

Reflection of light.

Refraction of light.

Effect of prisms on light transmitted.

Effect of lenses on light transmitted.

The camera lucida. Effect of lenses in same.

The Eyes.

Appendages.—The orbit, eyebrows, eyelids, eyelashes, conjunctiva, meibonian glands, caruncula, lachrymal glands, lachyrmal sac, nasal duct, tears.

The muscles of eyeball. Arteries of eye.

The Eyeball (pupil),—size, shape.

The tunics.—1. Sclerotic and cornea.

2. The choroid and iris. Ciliary processes and muscles.

3. The retina. Microscopic structure. Blind spot. Yellow spot.

The Humors.—The aqueous, crystalline lens, vitreous.

The optic nerve.—Position, origin, commissure.

References.—Gray's Anatomy. Martin, Chap. XXXI.

LECTURE XLIV.

Vision Produced.

An inverted image is formed on the retina.

Accommodation for light and distance is constantly taking place. Limits of accommodation. Line of direct vision. Field of vision.

Acuteness of vision, education of, persistence of impressions on retina.

A chemical change seems to take place on the retina. "Vision purple."

Color vision explained.—Vibratory theory. Young's.

Distance explained by size, visual angle.

Size explained by image on retina.

Solidity by binocular vision.

Roughness by alternating light and shadow.

Shine and brilliancy by reflection from numerous points.

Single vision with two eyes.

Reference.—Martin, Chap. XXXII.

LECTURE XLV.

Imperfections of the Eye.

Aberration.—Chromatic and spherical.

Irregularity of cervature.—Astigmatism.

Long sight.—Hypermetropic, presbyopic.

Short sight.—Myopia.

Color blindness.—

Cataract.—

Strabismus (squint, cross-eye).

Ptosis.—(Dropping of upper lid); paralysis.

Hygiene of the Eye.—Rules for its use and preservation.

Prevention of blindness.—

Reference.—Martin, Chap. XXXII.

LECTURE XLVI.

The Development of the Eye.

1. **No eye at all.**—
2. **Bright pigment spots.**—Ill. protozoans.
3. =2+**ganglia.**—Ill. jellyfish, starfish, leech.
4. =3+**crystalline lens,** rods and cones, "eye spots" of larval worms, echinoderms and molluscs.
5. =4+**vitreous humor.**—(Ill. entomostracans).

Simple Eyes.	**Compound Eye.**
6. **=5+iris.**—Ill. Spiders.	6. **Comp'd Eye** in many insects and crustaceans.
7. **=6+ag. humor** { Snails, cuttlefish, scorpion, some vertebrates.	7. Some insects and crustaceans.
8. **=7+choroid** gland (fish).	
9. **=7+pectin birds.**—	

Aquatic animals lack eyelids and tears.

Birds have 3 eyelids and bony plate in cornea.

Tapetum in night-seeing animals.

Vestigial eyes in cave animals.

References.—Carpenter's Comp. Phys. Orton, Chap. XVIII.

LECTURE XLVII.

The Ear.

The Nature of Sound.—Tansmission of sound waves.

External Ear.—Pinna and meatus. Protection of meatus. Structure. Muscles of ear.

Middle Ear.—Location, membranes, tympani, ossicles, muscles and ligaments, fenestrae, eustachian tubes, mastoid cells.

The Internal Ear.—Vestibule, cochlea, semicircular canals, membranous labyrinth, Perilymph, endolymph, ootoliths. The organ of Corti. Nerve distribution in cochlea and canals.

How we hear.—Range of hearing, accuteness, cultivation of hearing, auditory judgments.

Development of Ear.—

1. Organ unknown.
2. Ganglia+vestibule+ootoliths.
3. =2+semi circular canals. Ill. fish and amphibians.
4. =3+middle ear+stapes. Ill. reptiles.

5. =4+straight cochlea. Ill. Birds and some reptiles.

6. =5+complete cochlea. Bones of middle ear. Ear in mammals; insects. Development of external ear.

LECTURE XLVIII.

Voice and Speech.

Voice defined.—(Song, cry, call).

Organ of voice in aquatic animals, in insects, in reptiles, birds, mammals.

The Trachea.—Position, size; cartilages, muscles, ligaments.

The vocal cords.—True and false cords, position, nature, ventricle, cords tightened.

The production of voice.—Observations made by laryngoscope, changes in cords, modification of voice in passages beyond cords.

Essentials in production of voice.—Presence of cords, that they be tense, parallel, and that a current of air passes outward.

Variations in voice.—loudness, pitch, quality, range.

Varieties of voice.—Base, tenor, alto, soprano, falsetto, etc.

Range of human voice.—The ordinary is 3 octaves (176 to 1584 vibrations per second), maximum 366 to 4224 vibrations.

Cultivation of voice.—Capabilities, precautions.

Change of voice in boys and girls.

Speech defined.—Relation to hearing, speech of the mute. Ventriloquism.

Production of vocal and consonant sounds. Foster's table of consonant sounds.

Hygiene of vocal organs.—Precautions in cultivation of voice during period of change; after long speaking, while the cords are inflamed or diseased. Use of scarfs and mufflers.

Diseases.—Stammering, hare-lip, cleft palate, tongue-tied, ulcers of cord, consumption of cord.

References.—Martin, Chap. 36. Orton, page 188.

LECTURE XLVIII.

The Ages of Man.

Infancy, childhood, youth, manhood, old age.

Temperaments.—Sanguine, bilious, melancholic, phlegmatic, nervous.

Natural Differences.—Male and female. Minor differences.

Acquired Differences.—Habit, association, imitation.

Heredity and variability.— Atavism.

Average Duration of Life.—

Influences of Modern Civilization.—Competition produces physical exhaustion, weakened bodies, feeble minds, insanity and finally extinction.

Preservation of the weak and feeble. Survival of the fittest.

The commingling of different races.

Effects of civilization on savage and barbarous peoples.

References.—Dunglinson Human Physiology, pp. 591–655. Mills, 663–668.

LECTURE XLIX.

Disease.

Definition.—

Historical Sketch.—

Control and Prevention of Disease.-

Erroneous Ideas Concerning Medicine.—

1. That specifics for every disease are known.
2. That drugs *cure* disease.
3. That to do good, a medicine must act powerfully.
4. That any one can administer drugs.
5. That the sick can take vile compounds which would kill the well.
6. That medical sects have any sound reasons for existing.

Selection of a Physician.—

LECTURE L.

Death.

"Daughter of night, sister of sleep."

Molecular Death.—Causes, results.

Somatic Death.—

1. **Natural Death.**—Manner, causes.
2. **Accidental Death.**—Commences in heart, lungs, brain or blood. Euthanasia.

Physiogonomy after Death.—Cause of natural appearance.

Signs of Death.—

1. **Immediate.**—Absence of pulse and heart sounds. Relaxation of sphincters. Coldness and stiffness of body. Sinking of eye, dimness of cornea.
2. **Remote Signs.**—Rigidity. Rigor mortis. No muscular contraction under electrical stimuli. Putrefaction.

Feigned Death.—

Changes in body after death.—Restoration to elements.

Reference.—Dunglinson, Vol. II. p. 723.

LECTURE XLI.

Accidents and Emergencies.

Apoplexy, bites, hemorrhages, burns and scalds, choking, colic, cramps, convulsions, dislocations, drowning, fainting, fractures, lightening stroke, poisoning, railroad and steamboat accidents, starvation, storms, suffocation, sunstroke, wounds.

QUIZ QUESTIONS.

Into what *two* worlds may all matter be grouped?

Into what kingdoms?

Define Science, Biology, Anatomy, Histology, Physiology, Pathology, Embryology, Hygiene, Sanitary Science.

What forces produce inorganic bodies?

What organic bodies?

Which is the more simple in chemical composition?

Which is homogeneous; which heterogeneous?

Which indefinite in size; which definite?

Which amorphous; which crystallized; which bounded by plane surfaces, and which by curved surfaces?

How does the mineral grow; how the plant; the animal?

What is the duration of inorganic bodies?

What of organic bodies?

Of which is protoplasm the basis?

Is the basis of different minerals the same?

Which has no marked tendency to decay?

Has the organic body any tendency to decay?

Do all minerals make the same products in decaying; do organic bodies?

From what do plants and animals all spring.

Which are the more simple in composition?

Which consist of ternary comp'ds; which of quaternary comp'ds?

What substances characterize plants; what animals?

What animals have chlorophyll; what animals have cellulose?

Can plants always be distinguished from animals by the external form? give illustrations.

What is the internal structure of plants; of animals?

Why are plants called "up and down" structures?

Why animals "fore and aft?"

What materials nourish plants?

Is plant food digested before absorption?

Which is the more complex, plant or animal food?

Which continues to develop the longer, plants or animals; do any animals grow indefinately?

Do plants possess a nervous system?

Are plants sensitive; do they ever act as though they felt; do all animals feel?

Do plants possess voluntary motion; do animals possess involuntary motion; Ill.

How does plant respiration differ from animal respiration? Do plants ever breathe as animals?

What gas do plants inhale; what exhale? How do colorless plants breathe? What is chlorophyll and where found?

Why are plants thought to be injurious in sleeping rooms?

Do plants have definite excreta?

What are the constant and simple animal excreta? (Ans. CO_2, H_2O, NH_3).

Which is the constructive kingdom in nature; the plant or animal; which the destructive?

Name the chemical elements found in the human body; what four are found in largest amounts? What elements next in abundance in the body?

What ones in minute quantities; what ones found accidentally present? What elements are found free in the body?

What are proximate principles; name the inorganic proximate principles in the body; what is the most important one; the next?

What amount of water in the body? What tissue (or fluid) has the most water; what the least? How much water in the saliva?

What are the mineral substances of the bones?

What gives color to the body?

What gives taste to the perspiration?

What are phosphates, carbonates, sulphates; what are carbohydrates? Amylaceous bodies?

What is glycogen and where found; glucose, lactose; inosit? what are hydrocarbons?

What is the composition of fats? What is plmatin; olein; stearin; what is glycerine?

What is lactic acid; acetic acid; butric acid; formic acid?

What are the principle nitrogenous comp'ds. of the body?

Name two kinds of albumen? Give their properties.

What is fibrin? Case in; myosin; ptyalin; pepsin; pancreatin; mucasine; collogen; chondrine; kreatine; and where is each found?

What elements are found in amylaceous compounds; what in nitrogenous?

Do excrementitious substances contain nitrogen or not?

What do we know of the ultimate nature of life? State different theories. Give same definitions of life.

Name the phenomena which manifest life? What are some of the conditions necessary to the manifestation of life?

What is contractility; irritability; conductivity; spontaneity?

What is protoplasm?

Define organization; what connection is there between organization and life?

What are undifferentiated tissues? What are anatomical elements; what is the ultimate anatomical element?

What is a cell? Describe its parts. Which is the least vital portion of a cell; the most vital portion?

What is the most general shape of cells; what is their size; how do cells grow; how multiply; how do cells become tissues?

Name the principle tissues. What are automatic tissues; nutritive?

What are membranes?

What is a mucus membrane; a serous; a synovial?

What is an organ; a gland; an apparatus; a system; a function? What are animal and vegetable functions; which are the higher?

Why is it necessary to classify the animal kingdom?

What are the ideas about which groups are formed (*ans.* structure, physiology and embryology).

State Aristotle's classification; Von Baer's classification?

Give Lamarcks three groups. Give the system of Linnaeus, of Cuvier.

Why are systems of classification liable to change?

Give examples of protozoa, radiata, articulata, mollusca, and vertebrata. Give the great groups of vertebrates. Which are higher, articulates or molluscs?

Where is man placed in a system of zoological-classification?

The Supporting Tissues. (Skeleton.)

Locate your forehead, occiput cranium, temples, cheeks, cheek bones, chin, nose, roof of nose, eyebrows, eyelashes, ears, crown of head, neck, Adam's apple, shoulder, arm, forearm, wrist, palm, digits, forefinger, ring finger, hip, thigh, groin, knee, leg, ankle, instep, foot, shin, arch of foot, ball of foot, chest, thorax, abdomen, back, small of back, trunk, axilla, pit of stomach.

What is a skeleton? Is the skeleton ever external to the body? In what animals?

What are the three tissues in a skeleton?

What are the objects or uses of the skeleton?

How many bones in the human skeleton?

Why is the number differently stated? When is there the greatest no.?

What three natural cavities formed by the human skeleton? What does each cavity contain?

What are the three natural divisions of the skeleton?

How many bones in the cranium? How many in the face? In the trunk?

How many in each of the extremities?

What are the principal forms of bones?

What is the general shape of long bones?

What is the structure of long bones? Explain this. What fills the cavity in long bones of most animals? How is this in many water mammals? How in birds? Why?

Why are the bones of hand short?

What are condyles; tuberosities?

What is the head of a bone; the neck?

What is the composition of bone? How does this composition vary through life?

How may animal and mineral matter be removed from bones?

What is the proximal end of a bone; the distal end; the dorsal and ventral portions?

What is marrow; where found; use?

What is the purpose of mineral matter in bone?

What is the minute structure of bone?

What is peculiar in structure of bones of head?

How does the exterior of a bone differ from the interior?

What are Haversian Canals? What Lacunæ?

What is a foramen; nutritive foramina?

Where is the glenoid cavity?

What ingredient gives bones hardness? What gives elasticity?

What occasions rachitis?

What is ossification; when complete?

How are bones developed; how lengthened? How are bones repaired?

What is the periosteum; its use?

Where is the acromion process?

What is a suture? Where are the lambodoidol, the sagittal and coronol suture?

What are fontanelles?

Are the bones in children complete?

What are sinuses; their purpose?

What is the vertebral column?

Do the bones touch each other?

What is Cartilage, and where found?

What bind the bones to each other? What separate them from each other?

What is the condition of the bones of the head at birth?

Name and locate bones of cranium; the arm; the forearm. Which bone of the forearm rotates at the elbow?

How many bones in the wrist; in the hand?

What is the carpus? What are phalanges?

Into what parts is the upper extremity divided; the lower extremities?

What is the largest bone of the body? Where is it?

Which is the strongest bone in the leg? Which the outer one?

How many bones in the foot?

What and where is the patella; its object?

What is the most important part of the skeleton?

How many bones in the spinal column? What is its object; its principal divisions; upon what does it rest; what does it support; what contain?

What is its shape? Why is it curved; how many curves in it?

What substance between the separate bones; why?

What is peculiar in the spinal column of fish; reptiles?

What are the innominata bones? What is the pelvis?

How many ribs have we; their classes; purpose? What is said of ribs in the serpent; in the frog? What cavity do the ribs inclose; its contents?

What is the sternum; where is it? What is the sternum in birds? What animals have no sternum; why?

What evidences of design in the structure of the skull; of the chest, foot, pelvis, hand?

From what are bones of the head developed? *Ans.* Vertebræ.

Are the teeth true bones?

Why are the ends of long bones enlarged?

What is the axis; the atlas? What follows their dislocation?

On what bone does the head rest?

What and where is the os hyoides?

What are the sesamoid bones; where found?

Put your hand on the frontal bone, the malar bone, the radius, the ulna, the tibia, the humerus, etc.

What is a vertebrate; an invertebrate?

What kind of a skeleton has a turtle; a bird? Have beetles skeletons? Kinds?

Why has the dog no clavicle?

How many bones in the shoulder of a bird?

How many toes has a horse; a cow; a sheep; a dog; a cat; a chicken; a canary bird; a turkey?

Name good bone-building foods?

Why do the bones of the old break readily and repair slowly?

What is an axial skeleton; an opendicular skeleton?

What are natural and artificial skeletons?

What is the pelvic arch or girdle; the pectoral arch?

What is the hallux?

What are homologous bones? What is cancellation bone?

What is a medullary cavity?

What are bone corpuscles?

What is the diplaë?

What are the tables of a bone?

What is an internal periosteum?

What is geletine?

What are wormian bones?

What is ossification; when completed?

What are temporary and permanent cartilages; hyaline cartilage?

What is the perichondrium?

What is chondrin?

What is areola tissue?

What is white connective tissue?

How does yellow connective tissues differ from the white?

What is fibro-cartilage?

What is the "merry" or "worth-bone?"

How does the foot of a savage differ from the foot of a civilized man?

What is a felon?

How should a person with broken bones be handled when first picked up?

Joints.

What are the parts of a joint; how many classes?

What binds the bones together at a joint; what covers the ends of the bones?

What lubricates the joints?

What is the synovial membrane?

Where is a ball and socket joint; a hinge joint; a pivot joint?

What movements does a joint permit?

What is a sprain? Treatment? What is a dislocation?

How first treat a broken limb?

An injured joint?

How build up a healthy skeleton?

How many joints in your body; how many ball and socket joints?

What is rotation? Pronation? Supination? Circumduction?

What kind of joints in the spinal column?

What is a capsular ligament?

What is a round ligament?

What is the odontoid process?

What is a perfect joint; a gliding joint?

Why should an injured joint never be neglected?

What is anchylosis?

What is a false joint?

What is a symphysis?

Muscles.

What are muscles; how many in the body; shape; what are their uses; composition?

Does a contracted muscle become smaller? What is understood by a relaxed muscle?

How are muscles arranged; what is the color of muscles; what two classes of muscles?

What is the structure of the voluntary muscle; color?

What is the structure of the involuntary muscle; color?

Which is the more highly organized?

Which contracts the more rapidly?

Where are the voluntary muscle found; the involuntary muscle

Which kind of muscle is striated?

What kind is found in the hand; in the heart; what kind surrounds the blood vessels; what kind surrounds the intestines?

What is the object of muscles in these places?

What is the smallest muscle in the body? *Ans.* Stapedius.

Where is it? *Ans.* In ear; weight two grains.

What is the longest muscle in the body? *Ans.* Sartorius in the leg.

Where is the biceps muscle; the triceps muscle; the digastric muscle? What do these names signify?

What is the shape of the muscles about mouth and eye? What is a sphincter muscle?

Of what is the mass of the tongue composed?

What is muscular *tonicity*? *Ans.* Firmness.

What is perimesium?

What is an aponeurosis; a fascia?

What are muscular fasciculi, fibers, and fibrillae?

Is muscle elastic?

What is the primary use of muscles?

What are secondary uses?

What is a pinniform muscle?

How are muscles named?

How do muscles develope?

What are skeletal muscles; visceral muscles?

What is the composition of muscle?

What kind of muscles are found in vertebrates; In invertebrates?

Which class of muscles is of a pink color?

Which class is rapid in action?

Do plants have any muscles?

What is adipose tissue; where is it found; its use?

Where is the diaphragm? What does its contraction produce?

What is a tendon; what its use? What are leaders, cords, sinews? Where is the tendon Achillis? Are tendons elastic; why? What tendons work over pulleys? What tendons pass through other tendons?

When is an animal *hamstrung*?

What is a bursa?

What changes occur in a muscle during muscular activity?

Is the temperature raised in an active muscle?

What produces muscular force?

What effect has constant exercise on muscles?

What effect has much leisure or rest?

How can muscles be best developed and maintained?

Should the times of exercise be regular; why?

What is the best universal exercise?

What effect has long continued exercise on the muscles?

What amount of exercise is daily required; why do we need exercise at all?

How does exercise promote circulation?

Why should exercise be in the open air?

Why is unpleasant exercise seldom beneficial?

Why are calesthenics and light gymnastics of value?

Is carriage riding a good exercise?

What follows long continued pressure on a muscle?

Why can we not move our ears by the appropriate muscles?

Why is it more tiresome to stand than walk?

What is rigor mortis; what does it indicate; how long does it continue?

What is the irritability of muscle; does it cease at death?

What is the origin of a muscle; the insertion?

Which arm of the blacksmith is the larger; which one is the more healthy?

Why is the student's arm soft?

What is the muscular sense? In what parts of body most developed? In which hand best developed? Can it be educated? How?

Why should the muscular sense be educated?

What are convulsions; cramps?

What is lockjaw; an abscess; a boil; a carbuncle?

Body Movements.

What are amoeboid movements; how seen?

What are cilia? Where are ciliary movements seen?

What is a lever? How many classes of levers in the body? Give an illustration of each class in your own body.

Which class is most frequently employed in body? What are its advantages; disadvantages?

What class of lever in the arm; in the finger?

What class employed when we stand on our toes?

When we tap with the toes on the ground?

When we nod the head backward and forward?

How do we hold the head erect?

How do we stand?

Over what part of the foot does the weight of the body rest?

How do we walk?

Is the body *carried* or *thrown* forward in walking?

What movements does the head make as we walk?

What movements does the body make as we walk?

Why do we swing the hands as we walk?

When are we tallest, walking or standing?

Are the muscles *all* at rest when we sleep?

How do we run?

When lost, why do we wander in a circle?

Are we born right-handed?

What are digitigrade, plantigrate, and ungulate animals?

Do animals run, swim, or fly with greatest rapidity?

What is the greatest recorded speed of a horse?

How fast can a bird fly; an insect? How fast can a fish swim?

Which requires the greatest power, flying or swimming?

What is the source of muscular power?

The skin.

Of how many layers is the skin composed? How can these be shown?

What is the upper layer called; the lower?

What is the structure of the derma or cutis?

What is the structure of the pidermis or cuticle?

Which layer is elevated in a burn?

Where is the cuticle most developed; its object?

Which layer of the skin contains pigment cells?

What produces complexion? What is an albino?

Is the epidermis sensitive and vascular?

Is the epidermis repaired; how?

How is the skin of a snake repaired?

What are the functions of the skin?

Which function is the most important?

What is excreted through the skin?

How is the skin a protective organ?

What are the "pores" of the skin?

When are they most numerous?

Is it well to permit the pores to become closed?

How is the skin kept soft and plaint?

Where are the oil glands most abundant?

Do the ducts of these glands ever become closed ?

What are the "worms" of the nose ?

What are the perspiratory glands ? Where are they most numerous ? What is their united length ? What is their use ?

What is insensible perspiration; sensible perspiration ? What is daily amount of the perspiration ? What are the uses of the perspiration ? What is the composition of perspiration ? What is the taste of perspiration ?

Why does an animal die if varnished ?

Why is the skin roughened by riding in the cold air ?

How can the absorbing power of the skin be shown ?

How are painters poisoned ?

Why are medicines sometimes rubbed on the chest ?

How may hair dyes and cosmetics prove injurious ?

What effect has drenching the skin of a thirsty person ?

Do any animals breath through the skin ?

What are pachydermatous animals ?

Are there animals in which the functions of the skin are more important than in man ? When are the functions of the skin most active ?

What are pimples and how caused ?

What is a scar; a mole; a birthmark; a wart; a corn; the cause; the cure ?

How does the skin regulate the heat of the body ?

What is itch; ringworm ? What are bedsores; how prevented ?

How treat burns; why ?

Mucous Membrane or Internal Skin.

How does the skin change at the openings into the body ?

Is it the same kind of membrane as covers the heart and lungs ?

What is a serous membrane ? Is it sensitive and vascular ?

What membrane lines passages of the heart ?

What membrane lines passages and cells of lungs ?

What are cilia; their size and structure; where are they found; what is their object ?

What is their most peculiar characteristics ?

What is the constant direction of their motion ?

Do they exist in many animals; in plants ?

What purpose do they serve in the sponge and oyster ?

What is said of their vitality ?

What does the mucus membrane constantly secrete ? What is the object of the mucus ? How is the mucous membrane affected in colds ?

What effect does an extensive burn often have on the mucous membrane ?

What kind of membrane lines the passage of the head; the mouth; the stomach and intestines ?

What is nose-bleed ; cause ?

Appendages of the Skin.

Hair.

What are the appendages of the human skin ? *Ans.* Hair, nails, and teeth.

Why are they called appendages of the skin ?

What are other appendages in the lower animals ? *Ans.* Bristles, feathers, scales, horns and wool.

How is hair developed; at which end does it grow; what is its structure; its uses ?

When a hair has been plucked will it grow again ?

What turns the hair gray ? Can the hair turn gray in a single night ? Can the color of gray hair be restored ? Are hair dyes injurious ? How ?

Does hair grow after death ?

How is the hair made to stand on end? How does the horse move his hair?

What is the use of a cat's whiskers?

Is the hair liable to decay?

What causes baldness? Is it curable?

Is it more prevalent in men or women? Why?

What glands are associated with the hair?

Do they furnish sufficient oil for the hair?

Are the hairs of all animals alike in structure?

What is the structural difference between straight and curly hair?

What parts of the surface of the body contain no hair?

What are bristles? *Ans.* Coarse hairs.

What are feathers? *Ans.* Modified bristles.

What are wool and fur? *Ans.* Very fine hair.

What are scales? *Ans.* Modified hair.

What change does the hair of animals undergo on approach of winter?

Can the hair be changed by natural selection?

What temperament does light hair indicate; dark hair?

What is dandruff; how prevented?

Should soap be used on the hair?

Why does the hair fall out after severe fevers?

Do all mammals possess hair?

Why is the hair shed in the spring in wild animals?

What effect does climate have on hair or its modifications?

Why are polar animals white?

Why are tigers striped and spotted?

Nails.

From what are the nails developed; structure? What is their purpose?

At what end does a nail grow? How long does it require a nail to grow from skin out? How can you prove that nails grow?

What resemblance between nails, claws, hoofs and horns?

If removed, will a nail be restored?

How do the nails of bed-ridden persons sometimes grow?

What is cause of ingrowing nails; treatment?

What cause the white spots on our nails?

Why should painters careftlly clense the nails daily?

Are there nerves or vessels in the nails?

What peculiar organic principle in nails? *Ans.* Kreatine.

Is deer's horn, horn or bone? *Ans.* Bone.

How does a deer's horn differ from that of an ox or sheep?

Is there any bone in an oxe's horn?

How are nails *properly* trimmed?

What is the lunula of a nail?

Teeth.

To what tissue do the teeth belong?

Are they bone in structure or composition?

How are they developed?

How manp sets of teeth have we; their names?

How many deciduous or milk teeth are there?

How many permanent teeth?

Where and how many are the incisors; the canine teeth? How many permolars or bicuspids? How many molars; their use?

Which are the last teeth to appear; where?

When are the milk teeth shed?

How many roots have the teeth?

When do the first teeth appear?

What is the natural order for appearance of the teeth?

What are the three parts of a tooth?

What is the crown?

What is the neck?

What is the fang?

What is the structure of a tooth?

What and where is the dentine?

What is the enamel; how arranged; structure?

Is there any true bone in a tooth?

What fills the cavity of the fang?

Is this pulp sensitive?

Is there ever a third set of teeth?

Do the teeth change as bones do and repair waste?

Are they worthless when the pulp is dead?

Can teeth be transplanted?

Is there direct union between teeth and jaw bone?

What is tartar on teeth?

Is it injurious? How?

Should decayed teeth be removed; why?

Should an aching tooth always be removed; why?

Do decayed teeth ever cause neuralgia? *Ans.* Yes.

Do they ever cause lung complications; how?

Do they ever cause dyspepsia; how?

What effect have decayed teeth on the breath?

What differences between the teeth of the carnivora and herbivora?

What seems to be the object of teeth in the carnivora?

What is the object of teeth in snakes and fish?

What is the arrangement of fishes' teeth?

What is the fang of the rattlesnake?

What are tusks? Why does the tusk of the walrus point down? Its use?

What is peculiar in the teeth of gnawing animals? What occurs if one is broken? How is the enamel arranged on their teeth?

What is peculiar in the tooth of the horse?

Has the cow any upper teeth front; why?
What is said of teeth in the order Edentata?
Are children ever born with teeth?
Where are the teeth of the lobster and crab?
Where are a bird's teeth; snails; turtles?
How does a hard and gritty substance effect the teeth?
How do very hot or cold substances effect the enamel?
What kind of a tooth pick should be used?
What kind of a tooth brush? Why?
What effect have particles of food between the teeth?
Is tobacco a preservative of the teeth?
Are vegetable growths ever found in the mouth? Where?
Why are the negroes' teeth so generally good?
What animals shed a set of teeth before birth?
What is peculiar in sharks' teeth?
How do you explain the rapid decay of teeth among Americans?
When a tooth is extracted, is the jaw-bone exposed?
What becomes of the roots of the first set of teeth?
Why should a dentist examine our teeth at frequent intervals?
After death, do the teeth decay readily?

Care of the Skin.

How should the skin be cared for?
What is the best time for bathing; why?
Which is preferable, hot or cold baths; why?
What is the general effect of a hot bath; a cold one?
What should be the signal for leaving the bath?
Should we bathe just after a full meal; why?
How should reaction be started after a cold bath?
Why is sea-bathing so beneficial?
What length of time should one remain in the Sea? *Ans.* 15 minutes to half hour.

What is a steam bathe; a sponge bath?

What is a sun bath; a turkish bath?

How do plants that grow in the shade appear; why?

How frequently should we bathe?

In a state of nature would it be proper not to bathe?

Would it at present be expedient not to bathe?

Should we use soap liberally on the body; why?

Is it well to bathe the sick; when; how?

Can the weak and aged bathe so freely as the vigorous adult? *Ans.* No.

Why do babies need bathing so frequently?

Does the skin become less active with age?

Does the activity of the skin vary with different individuals?

Clothing.

What is the primary object of clothing?

What are the essentials of clothing? *Ans.* Lightness, looseness, durability, readily cleansed.

What are the principal varieties of clothing material?

What can be said of linen as a clothing? At what season should it be worn if at all; why? Should it ever be worn next to the skin; why?

What can be said of cotton as a clothing; is it warmer than linen; why?

What is cotton flannel?

Why are woolen garments so warm; Should they be densely or loosely woven? Do woolens absorb moisture readily; do they part with it readily?

Why should woolen garments *always* be worn next the skin?

Is fur clothing of value? Silk?

How does the snow clothe the earth?

Which color absorbs most moisture?

Which color absorbs most heat?
What color of clothing is best for summer; why?
What color is the best for winter; why?
What color has the clothing of Arctic animals?
Why should clothing be light?
Which is better, one heavy garment or several light ones?
Why should clothing be loose?
How should the feet be clad?
How should the head be clothed?
Why do tight boots and gloves cause cold feet and hands?
Should the throat be muffled up when we go out?
What can be said against the use of veils?
How should the sick be clothed?
How should children be clothed?
How should the aged be clothed?
Do we as a rule wear too much or too little clothing?
Why does a fat man not need so much clothing as the lean one?
Why should not water proof clothing be constantly worn?
Why are rubber boots and overshoes injurious if constantly worn?
Why should we *always* be covered when lying down?
From what part of the body should the clothing be suspended?
Why are garters often injurious to the child?
If used where should they be tied?
Should we ever go with wet feet; why?
What kind of clothing should fishermen wear?
Of what material should clothing for soldiers be made?
For sailors and boatmen; why?
What kind of clothing should furnace men wear?
How can houses be warmly clad?
What value has paper as a covering for the body?
Is excessive clothing in summer injurious?

What kind of outer clothing should nurses and physicions wear?

Disease germs are carried in what kinds of clothing most readily?

What should be done with the clothing of those who have had contagious diseases?

Why should bed clothing be aired daily?

How are whales protected from cold?

Are the hairs in a fur bearing animal all of the same length?

Nervous System,

What is the object of the nervous system?

What is its general structure?

What are the two kinds of nerve matter?

What are the functions of the gray matter?

What are the functions of the white matter?

What is the structure of each?

What is a ganglion?

What is *nerve*-force; its velocity?

What is the arrangement of the white and gray matter of brain?

What membranes surround the brain?

How does structure of skull protect the brain?

What proportion of the blood circulates in the brain?

What is the weight of the normal human brain?

Where is the cerebrum?

How much of the brain does it form?

What is the object of the convolutions?

Do these appear in the brain of lower animals?

Are they constantly the same in man through life?

How is the cerebrum divided; what does this indicate?

Does each hemisphere preside over its own side of the body?

What animals have larger cerebri than man?

What are the functions of the cerebrum?

Is the cerebrum necessary to life?

Have different parts of the cerebrum different functions?

How can the brain be developed?

Why do brain workers need much sleep?

Does a large head necessarily indicate much brains?

Where is the cerebellum; its appearance?

What is the arrangement of the white and gray matter?

What is the arbor vitæ?

What is the size of cerebellum; its function?

What is the medulla oblongata?

Why is it called the "tripod of life"?

Can the medulla be injured with impunity?

Why is a carbuncle dangerous on the back of the neck?

Where does the spinal cord originate? Through what opening does it pass from the skull? How long is it? In what cavity is it protected?

Does it extend to the bottom of the spinal canal?

What is the arrangement of the white and gray matter?

Is the cord solid or has it divisions?

What are the functions of the cord?

How many columns has the cord?

What is the arrangement of gray matter in the cord?

What is a nerve trunk?

What is the structure of a nerve

What are the great classes of nerves?

What are excito-motor nerves; what inhibitory nerves?

How many cranial nerves are there?

Where do they arise?

Where do they leave the skull?

What is the first pair of cranial nerves?

Where do they leave the cranium; through what bone?

Where are they distributed?

What is their function?

What is the second pair of cranial nerves?

Where do they terminate; how?

Where do they enter the orbit?

What peculiar arrangement of optic nerves within the skull?

To what are the third, fourth and sixth pair distributed?

What is the function of fifth pair?

How many branches has the fifth pair of nerves?

Where is each distributed?

What nerve is effected in toothache and neuralgia?

What is the function of the seventh pair?

Where is the eighth nerve distributed?

What are the nerves of taste?

Where is the tenth nerve distributed? Why is it called pneumogastric? Where does it arise?

What are the functions of the eleventh and twelfth pairs?

What nerve gives expression to the face?

What nerve gives motion to the muscles of the face?

What nerve gives motion to the tongue?

Do these nerves all arise within the skull?

How many spinal nerves are there?

Where do they arise?

How do they emerge from the spinal canal?

How many roots has each?

What is the function of the anterior root; of posterior?

Which root contains a ganglion?

Where do these roots unite?

After union can one root be distinguished from another?

What course do these roots take after leaving the spinal canal?

Where do the motor fibers cross; the sensory?

Which side of brain presides over right side of face?

What follows disease of one side of brain?

What follows disease of a section of spinal cord?

What follows injury to one side of cord?

If motion is lost on right side of body and sensation on the left side, where is the injury?

What is the structure of the sympathetic system; its object?

Over what functions and organs does it especially preside?

What control does it exert over the circulation?

How does it regulate the size of the blood vessels?

What is reflex action; its object?

To what part of the nervous system does it belong?

Can it be cultivated?

How can we play a tune and talk at the same time?

How does reflex action affect the countenance?

How can we grow beautiful?

What is the cerebro-spinal nervous system?

What is the sympathetic system?

Which system only exists in invertebrates?

Do vertebrates possess both systems?

What are inhibatory nerves? Illustrate.

What is paralysis?

What is hemiphlegia; paraphlegia?

Why does a severe blow on the head produce unconciousness?

What is the effect of pressure on the brain, as by a fractured bone?

What is a sporadic ganglion?

Where is the solar plexus; what is it?

What is the dura mater; pia moter?

What is the cauda equina?

Where is the sciatic nerve?

To what disease is it subject?

What and where are the olfactory lobes?

What are the ventricles of the brain?

How many ventricles are there?

What do they contain?

What is the pineal gland?

What is the optic commissure?

What is the cardiac flexus?

What is the seat of pain?

When a nerve is irritated in its course, where is the pain felt?

Explain how pain is felt in amputated limbs.

Why is the pain of incipient hip disease first felt in the knee?

What is the effect of too severe labor on the nervous system?

What is the effect of loss of sleep; or worry?

Do hereditary traits extend to the nervous system?

How does the use of stimulants and narcotics affect the nervous system?

How is this system best maintained in health?

What is the pituatory body; where is it?

What is lock-jaw.

What is neuralgia; epilepsy?

What is "softening of the brain"?

What causes convulsions?

What is locomotor ataxia; hysteria; chorea; hydrocephalus; paraphlegia; hemiphlegia?

What is paralysis; paresis?

What is nervous exhaustion?

Do all animals possess a nervous system? Do all have a brain? Do insects feel?

Food

What is food; why is it needed?

What is the source of all organic foods?

How are foods prepared from the earth for use of animals?

What are the uses of food?

What are the classes of foods?

What are the most common mineral foods?
What is the composition of water?
How much water do we need daily?
What purpose does it serve in the body?
Should drinking water be chemically pure?
What impurities does it often contain?
What causes hard and soft water?
What proportion of the body is water?
Should we drink much ice water?
Should we drink water during meals?
How is water eliminated from the system?
What is the use of common salt as a food?
Can we obtain enough salt in our meats and vegetables?
Is salt a necessity as a food; what purpose does it serve?
Where among foods should oxygen be classed?
What amount of it is daily consumed; its use?
Where is oxygen discharged from the body?
In what form is it discharged?
How do we obtain the lime and magnesium we need?
How the iron, sulphur and phosphorus?
What are some of the cabonaceous foods?
Into what two classes are they divided?
What chemical elements contained in sugar?
Why are starches, dextrine and gums classed here?
What are the physical appearances of starch; its sources?
Does starch dissolve in water?
Can these carbonaceous substances be changed to sugar?
Is starch found in the human body?
What are the sources of sugars?
Is sugar produced in the human body?
In what organ of the body is sugar produced?
What variety of sugar is it?

What do sugars eaten in excess produce?

Is sugar harmful eaten in excess?

Is there any demand for sugar in the body?

How do the fats differ from sugar; how chemically?

What substances form fats?

What are the sources of fatty foods?

Are fats essential foods?

In what states of the system is fat much needed?

Will fat dissolve in water?

Is there any fat in milk; what is it?

What is the difference between tallow and lard?

How does butter differ from lard?

What is oleomargarine?

Why are nitrogenous foods so called?

Is nitrogen more abundant in animal or vegetable foods?

Name the more important nitrogenous foods?

What is the source of albumen as a food?

What is understood by coagulation of albumen?

What is the source of fibrin?

Where is casein found?

What is gluten and where found?

Of what does meat consist; eggs?

What are the constituents of milk; of cheese?

What vegetables contain a large amount of nitrogen?

How do nitrogenous foods leave the body?

What may be considered the average daily amount of food?

What circumstances cause this amount to vary?

Why do we need a mixed diet?

What reasons for our having a varied diet?

What is the best single food? *Ans.* Milk. Why?

Why are meats such valuable foods?

Is salt meat as nutritious as fresh meat; why?

What are *Trichinæ* and where found?

How are they avoided?

Why are fish a valuable food?

What kinds of fish are frequently indigestible?

What can be said of veal as a food?

What can be said of pork as a food?

Can life be sustained long on either starch, albumen, or fat alone?

Are all vegetable substances fit for food?

What food principle does bread lack?

Why should flour not be bolted?

What can be said of rye, buckwheat, and oats, as foods?

What of rice, peas and beans?

What can be said of Indian corn as a bread stuff?

Why is hot bread often unwholesome?

Why should bread be made porous?

What is the composition of the potato?

How does the sweet potato differ from the common potato?

What important foods belong to the botanical family solanaceæ?

Why should ripe fruits be largely eaten?

Which is the more nutritious, the potato or the apple?

Are syrups and molasses injurious?

What are the essentials of a perfect diet?

What precautions should be observed in the use of canned fruits and meats?

Whence is plant food derived?

What are the foods of herbivorous animals?

Of carnivorous animals?

Why is man called omnivorous?

What is the object of condiments?

What follows their excessive use?

What objections to their use?

When may vinegar be valuable; when injurious?

How does pepper act?

What can be said of mustard; of horse-radish?

What are stimulants?

When should tea be used; when not used?

What is the active principle in tea?

Why does tea blacken a steel knife?

How is tea best made?

Should it be used with milk and sugar, or not?

What is the active principle in coffee?

Which contains more theine, tea or coffee?

How is coffee best prepared?

What are substitutes for coffee?

How may coffee prove injurious?

When is coffee a most valuable stimulant?

How does it compare with alcohol?

What is chocolate; its active principle? Does it contain anything else beside theobromine?

What is the active principle in tobacco? What is its effect in small quantities?

In large quantities?

What is the source of alcohol?

Is the alcohol or "spirit" in all liquors the same substance.

What is wine; brandy; gin?

What is beer; ale; porter; whisky?

Does alcohol nourish the body?

Does it produce heat or force?

What is the effect of alcohol on the system in health?

What is its effect in disease?

When should alcohol be administered to the sick?

Are the effects of alcohol hereditary?

What can be said of opium as a stimulant?

What are the conditions to which it leads?

What is hunger; thirst; where located?
How often should one eat; how much?
In what manner should one eat?
When should one eat?
Why should children avoid tobacco?
Why should children avoid tea and coffee?
Are there any safe substitutes for tea and coffee?
Why should milk be selected with care?

Cooking.

What are the objects of cooking?
How should meats be boiled; how broiled; how roasted?
Why is frying a bad method of cooking?
How should soups be made?
What is said of hard and soft water in cooking?
What change occurs in albumen when cooked?
Why may a hard-boiled egg be unwholesome?
Why is roast meat so nutritious?
Why is warm food easier to digest than cold?
Why should ham and sausage be thoroughly cooked?
What changes take place in potato and apple when cooked?
When are dumplings unwholesome?
Should rancid fats and butter be eaten?
What meats may be eaten raw?
Why are some vegetables better cooked than raw?
Why should water and milk be boiled before drinking?

Alimentation.

Prehension.

What is prehension?
How accomplished in man?
What are the organs of prehension in horse and ox?
In the elephant and giraffe?
In the carnivora; in fish; in serpents; toads?
What follows prehension?

Mastication.

What is mastication ?
How many teeth in each jaw ?
With what teeth do we grind our food ?
Why should the food be well masticated ?
How do the tongue and cheeks assist mastication ?
What motions have the jaws in man ?
How does the horse masticate ?
What is the motion of the jaws in carnivora ?
How can we tell to what class of animals a skull belongs ?
What is meant by "chewing the cud" ?
How do birds masticate their food ?
How does the lobster masticate his food ?
Do spiders and flies masticate their food ?

Insalivation.

What is mixed with the food during mastication ?
What are the sources of the saliva ?
What is its composition and amount ?
Upon what part of the food does it act ?
What mechanical purpose does it serve ?
What peculiar principle in saliva; its use ?
How can the flow of saliva be induced and increased ?
How does saliva assist the taste ?
Do birds secrete saliva; where ?
What animals secrete very large amounts of saliva ?
What animals secrete no saliva ?
Is saliva secreted by young infants?
Should saliva be discharged from the mouth ?
What effect has mercury on the flow of saliva ?
What are mumps ?
Where is the parotid gland; the submaxillary ? Sublingual ?

Deglutition.

In what shape is the food swallowed?

Is deglutition a voluntary or an involuntary act?

What two tubes open into lower part of pharnyx?

How is the food conducted past the trachea into the œsophagus?

What is the œsophagus?

What is the alimentary canal; name its parts?

What is the action of the œsophagus in swallowing?

How is the food returned to the mouth in ruminating animals?

How does a juggler drink standing on his head?

How long does it require food to pass from mouth to stomach?

Can we swallow with nothing in the mouth?

How is vomiting accomplished?

Is it easier for an infant to vomit than for an adult?

Can birds readily disgorge their food?

How does the snake swallow; the bird?

Stomach Digestion.

Where is the stomach located?

What is its shape and its structure?

What membrane on inside; on outside?

What is the pyloris?

What is the size of adult stomach?

What is the size in the infant?

What fluid acts upon the food in the stomach?

Upon what class of food does it act?

Into what does it change this food?

How long does stomach digestion ordinarily continue?

In what condition does the food leave the stomach?

What is the daily amount of gastric juice?

What is its reaction; what acid does it contain?

What peculiar principle in gastric juice?

Why are soda biscuits injurious to stomach?
How is the food and gastric juice mixed together?
What excites the secretion of gastric juice?
What effect has the gastric juice on decomposing food?
Why does it not digest the walls of the stomach?
Is the gastric juice constantly secreted?
How does fright or mental occupation influence its secretion?
Has the stomach any power of motion?
What kind of muscle in the stomach wall?
What is chyme?
How long does food remain in stomach?
Why does headache often accompany a deranged stomach?
What is dyspepsia?

Intestinal Digestion.

What are the fluids of digestion in the intestines?
What is the source of the pancreatic juice?
What and where is the pancreas?
Where does its secretion empty into the intestines?
What is its agency in digestion?
Upon what element of the food does it act?
What particular principle in the pancreatic juice?
What is the daily amount of this fluid?
Is it constantly secreted?
What is the source of the bile?
Where is the liver situated?
What is its size as compared with other glands?
What is the daily quantity of bile?
Is it a constant or intermittent secretion?
What and where is the gall bladder; its use?
What is the agency of bile in digestion?
Besides bile, what does the liver produce?

What effect has the bile on the peristaltic action of intestines?

What vessels carry blood to the liver?

What ones carry it away from the liver?

What change occurs in blood passing through liver?

What is the last digestive fluid; its source?

What purpose does it serve?

What is the peristaltic action of the intestines?

What effect does this have upon the contents of intestines?

To what conditions is the food reduced by these fluids?

What is chyle?

Absorption.

Where does absorption take place?

Is any food absorbed through walls of stomach?

Into what vessels is it taken?

What are the special absorbents of the intestines?

What is the structure of the villi?

What changes occur in the large intestines?

What are the lacteals?

Where do the lacteals commence and where terminate?

What are the valvulæ conniventes?

What is their use?

Where in the intestines are they found?

Does absorption take place in the large intestines?

Sanguification.

What is meant by sanguification?

Where is blood produced; from what is it formed?

What kind of corpuscles are first formed?

Where are corpuscles formed?

Circulation.

What are the fluids of circulation?

What are the organs of circulation?

What is the quantity of blood in the body?
Of what is the blood composed?
How many kinds of corpuscles?
What is the proportion of red to white corpuscles?
What is the shape and size of the red corpuscles?
What is their office; their source?
What is the shape and size of the white corpuscles?
What is their source?
What is the plasma of the blood?
What is the fibrin; its use?
What is the albumen of the blood; its purpose?
What substances form the clot?
What forms the serum?
What are blood crystals?
What is the shape of the red discs in the camel tribe?
What is their shape in birds?
In what animals are the discs nucleated?
Can the blood of a bird be distinguished from that of man; how?
From that of the dog or monkey?
Do the blood discs of the embryo differ from those of adult?
What metal exists in the red discs?
How long do the red discs live?
What changes occur in blood passing through lungs?
What is eliminated from the blood in lungs?
What is absorbed by blood in lungs?
What is color of blood entering lungs?
What is its color leaving the lungs?
Is blood heavier or lighter than water?
Has blood any odor?
What is plethora; anæmia?
What is chlorosis?
What are the functions of blood?

What are the functions of red corpuscles?

What is blood-poisoning?

What is diabetes?

How do we know when an artery bleeds?

How long does it take for the blood to pass through body?

What is understood by a cold-blooded animal?

Does the blood circulate in hibernating animals?

What is removed from the blood passing through kidneys?

What are the *forces* that circulate the blood?

Why is the heart insufficient for the work?

How does elasticity of arteries influence the circulation?

How does muscular action assist in circulation?

How do the valves of veins assist in circulation?

How does the heart propel the blood?

How does capillary force influence the circulation?

Does evaporation of prespiration influence the circulation?

How does respiration promote the circulation?

How does osmosis promote the circulation?

What are the greater and lesser circulations?

Trace blood from right ventricle through body back to starting point.

What is the vital fluid?

What is transfusion of blood?

Who discovered the circulation of the blood? *Ans.* Dr. Wm. Harvey, England, 1619.

What is the circulating fluid in plants?

What is the nature of blood in insects?

What is the great object of blood?

What is the systemic circulation; the pulmonary?

What is the portal circulation?

What is the lymph?

What is its source?

Through what vessels does it flow?
Where does it enter the veins?
What kind of corpuscles in it?
What forces circulate the lymph?
Where does the thoracic duct lie?
What and where are lymphatic glands?
What is their probable use?
To what diseases are they subject?
What is the chyle; its source; its appearance?
What is its destination; how reached?
Where is it transformed and into what?
What is the cardiac circulation?
Is the blood ever diseased?
What is "blue blood"?

The Heart.

Where is the heart; by what organs surrounded?
By what membrane is the heart surrounded?
What is the shape and size of the heart?
Of what tissue is the heart formed?
Into what cavities is the heart divided?
Describe auricles and the ventricles?
Which side of the heart has the thicker walls?
How are walls of auricles strengthened?
What openings between the auricles and the ventricles?
How are the valves of the heart strengthened?
Into which side of heart does the venous blood come?
What vessel carries the blood from the heart?
Are there valves where the veins open into the heart; why?
Are there valves where the arteries leave the heart?
Why are there valves in the one case and not in the other?
What is the systole of the heart; the diastole?

What are the sounds of the heart; when are they heard; their cause?

What is the beat of the heart; where is it felt?

How often does the heart beat per minute?

What effect does rheumatism often have on the heart?

What kind of a heart has the bird; fish; reptile?

Describe the circulation in an insect?

What is peculiar in the heart of the mussel?

What is the nature of a heart valve?

Does the heart beat unceasingly?

Has the heart great vitality or not?

What functions did the ancients attribute to the heart?

What change takes place in the heart at birth?

What nerve controls heart's action?

How is rythm of heart's action produced?

Is a wound to heart necessarily fatal?

The Arteries.

Where do the arteries commence and where end?

What is their structure; why are they elastic?

What is the aorta; where does it arise; course and shape?

In what direction do the arteries carry the blood?

What kind of blood do they carry?

What do they contain after death?

In a piece of flesh, how are the arteries recognized?

What is the office of muscular tissue around small arteries?

Where on a limb are arteries usually situated?

Is their course straight or crooked?

Have arteries any valves?

What is the pulse; where is it felt?

How is hemorrhage from an artery stopped?

What is calcification of arteries?

The Capillaries.

Where do the capillaries commence and where end?

Why are they called capillaries; how large are they?

What changes occur in blood passing through capillaries?

What is the arrangement of capillaries in the body?

Are the capillaries elastic?

Explain blushing; pallor?

Why is the nose of the tippler red?

Can the blood be seen passing through the capillaries?

What changes occur in blood passing through capillaries of lungs?

In capillaries of body?

How long is each capillary?

The Veins.

Where do veins commence and where end?

How do they differ in structure from the arteries?

Have they valves; in what direction do they open?

What is the direction of the blood current in veins?

What kind of blood do veins carry?

Is the course of the veins straight or tortuous?

Where are the jugular veins?

Where the venæ cavæ? Where the portal vein?

What is the lymphatic circulation; its fluids?

Where does it commence and where does it end?

What forces drive the lymph; does the heart act here?

Where is the thoracic duct; its size?

What connection between lymphatic circulation and the lymphatic glands?

What are the lacteals; their uses; where found; in what do they commence?

What are villi; their structure?

Where are the jugular veins?

Where is the portal vein; the hepatic?

Which has the greater capacity the arterial or the venous system?

Respiration.

What is respiration; its object?

Name the passages the air traverses to reach the lungs.

Where are the lungs situated?

What is the *pleura*; its purpose?

What membrane lines the bronchii?

Where is the trachea; the epiglottis?

What is the structure of the trachea?

In what do the bronchioles terminate?

What are lung cells; how many are there?

How thick are their walls?

What amount of surface do they present? *Ans.* 128 sq. ft. to 2300 sq. ft.

What is their object?

What is the full capacity of the lungs? *Ans.* 350 cu. in.

What is tidal air; residual air?

Complementary air; supplementary air?

What changes take place in breathed air?

How are the gasses exchanged in the lungs?

How can *carbonic acid*, water vapor and organic motter be shown in expired air?

How often is ths act performed?

What part does the diaphragm play in respiration?

How does the act differ in the male and female?

What is inspiration, and how performed?

What is expiration?

What is the composition of the expired air?

Is respiration a voluntary or involuntary act?

What are the normal constituents of the air?

What are its common impurities?

How is its composition kept constant?

What is the effect of breathing carbonic acid?

What is the effect of breathing impure air?

What is the effect of breathing pure oxygen?

What is the effect of breathing very dry air? Rarified?

How does impure air affect the mind?

How does nature purify the air?

What is the object of ventilation?

How can it best be attained?

What is perfect ventilation?

How can the air in a sick room be kept pure?

Is night air injurious?

What does the fish breath?

Why does the fish rest with the mouth up stream?

How do insects breathe?

How do frogs breathe?

Why can the turtle remain so long under water?

How can the water in an aquarium be kept pure?

Why can we see our "breath" in cold weather?

Why should we breathe through the nose?

Why do we sigh?

Does water enter the lungs of a drowning person?

Why does water in a bed-room become impure?

Do hibernating animals breathe?

What class of animals can live in impure air? *Ans.* Cave dwellers.

Do plants breathe? What do they breathe?

What is coughing; sneezing; snoring?

How do laughing and crying differ?

Have they any value?

What is hiccough?
What is a cold; catarrh; croup; quinsy?
What is bronchitis; pleurisy; pneumonia?
What is asthma; consumption? What is asphyxia?

Assimilation.

What is assimilation?
Where does it occur; in capillaries or glands?
What part do cells play in assimilation?
Is assimilation a chemical or a physical process?
How does repair to a part occur?
How is a bone repaired?
How does assimilation produce heat?
Do all foods nourish the body?
What are storage foods?
May the same substance be used more than once in body?
What is metabolism?

Calorfication.

What is the normal temperature of the body?
Is this constant under all climates and seasons?
How is this heat produced; how distributed?
How maintained at a constant point?
Where is vital heat produced?
Is the interior of the body warmer than the exterior?
Is the blood of birds warmer or cooler than that of man; of fish?
What relation between vital heat and the perspiration?
How does severe exercise produce heat?
What foods produce heat?
What foods produce most heat?
Is a high heat of the body injurious?
How high does the blood become heated in fevers?
When a part is frozen, how should it be treated?

How should cold feet be managed ?

Which should be the warmer, the head or the feet ?

Can any animals be frozen stiff and again resuscitated ?

Is the temperature raised or lowered in sleep ? In hibernating animals ?

Is the temperature in plants subject to change ?

When is the temperature in plants greatest ?

Why are students subject to cold feet and hot heads ?

Does alcohol produce heat when used as a beverage ?

What are some principal chemical changes in the body ?

Secretion.

What is secretion; how different from excretion ?

Where does it occur ? Name five secretions ?

State their uses ?

What is bile; where found ?

What are ductless glands ?

Name two ductless glands.

How is secretion accomplished ?

State the structure of the sebaceous glands.

Give structure of parotid gland.

Name secretions which are used two or more times and then absorbed into the blood.

What glands atrophy after birth ?

What is the largest gland before birth ?

Disassimilation.

What is disassimilation; Where does it occur ? What are its products ?

Does it also produce heat ?

How often is the body renewed ?

What parts change most rapidly ?

What is the daily average waste of body ?

Do any parts exist without change during life?

Into what do the tissues change in disassimilation?

What is the "vortex" or "eddy of life"?

Does disassimilation occur as one process, or several?

What are the final products of disassimilation?

Excretion.

What is excretion? What are the organs?

What do the lungs excrete; the kidneys; the bowels?

What does the skin eliminate?

What organs eliminate most water?

Where is organic matter eliminated? Urea?

Why do the lungs become congested in extensive burns of the skin?

How does the intestinal tract eliminate waste matter?

Can one excretory organ perform the work of another?

Is the liver a secretory or excretory organ?

Where are the products of excretion formed, in the tissues, the blood, or in the excretory organ.

Give the history of urea?

Special Senses.

Define impression, impulse, neurosis, psychosis, conciousness, sensation, perception, conception, judgment.

What is the seat of all sensation?

What is common sensation (general sensability)?

What is a simple sensation? Compound sentation?

What are subjective sensations?

In what three respects do sensations differ?

What is differing in modality; in quality and intensity?

How are sensations referred?

What do our sensations tell us?

What is unconcious cerebration.

What are sensory illusions?

What are the intermediate senses; what special senses; how many?

Is appetite a sense; thirst?

Restlessness; nausea; smell; temperature?

Is there a distinction between feeling and touch?

Touch.

What is the organ of touch in man?

Where is touch most acute; most delicate?

How do the nerves terminate in the skin?

What is a papilla?

How many are there on a square inch of hand?

How do nerves end on the surface of the body?

How does the cuticle assist the sense of touch?

When the cuticle is removed, what does touch become?

Does touch aid us in attaining ideas of solidity?

Is touch always reliable in sensations?

Can the sense of touch be educated?

What is the *tactus eruditus?*

Why is this sense well developed in the blind?

What is the organ of touch in the bat; in snake; in birds; in dogs; in insects?

What is the use of touch; is it ever lost in disease?

When a nerve is irritated, to what point does the brain refer the injury?

Why is incipient hip-disease felt in the knee?

Substances are perceived by feeling as in what physical condition?

In an amputation where is the greatest pain felt?

Does the sense of warmth or cold differ from that of touch?

Where is the sense of temperature most developed?

Is the sensation of heat or cold absolute or only relative?

Can the sense of temperature be lost and feeling remain?
How do very hot or cold bodies feel?
What is pain?
What is muscular sense?
How does it differ from touch?
Where is this sense most developed?
Can it be educated?
Is it of any practical value?

Smell.

What is the simplest sense?
What is the apparatus of the organ of smell?
What cranial nerve supplies it?
Where is this nerve located? Upon what bone spread out?
Into what does the cavity of nose open behind?
By what bone are the nasal cavities separated?
What are the uses of these senses?
Can we become accustomed to bad and impure smells?
Why do we sniff in the air to get a good smell?
In what condition must a substance be to be smelled?
How does smell serve respiration?
How does a "cold in the head" affect smell?
What is sneezing and its object?
In what acts besides smelling do the nasal cavities participate?
What is the object of the external nose?
What is its structure largely made of?
How is this sense developed in some animals?
How may a foreign body be removed from cavity of nose?
Can all dangerous gases be detected by smell?
How does smell compare with the other senses in acuteness?
Can this sense be cultivated?
What is a "cold in the head?" Catarrah?

Taste.

Where is the sense of taste located?

In what structures is taste probably perceived?

What is the structure of the papillæ of tongue?

What two nerves give sensations of taste?

Where is each distributed?

Is the sensation the same on sides, base and tip of tongue?

Why do some substances when tasted distort the face?

In what physical state is a body tasted?

With what other senses is the taste closely connected?

How does the saliva assist the taste?

What is the object of taste?

Can this sense be cultivated?

When sick, why do all things taste alike?

On what does flavor depend?

What tastes depend upon touch, or feeling?

What is the effect of condiments upon the taste?

How does taste in children compare with that of adults?

Can vicious tastes be inherited?

How does a cold in the head affect taste?

The Eye.

What cavity contains the eye? Its shape?

What bones form this cavity?

With what is it lined and padded?

Where does the optic nerve enter it?

What is the nature of the roof of this cavity?

What is the shape of the eyeball? Its diameter?

How many coverings has it?

What is the outer covering called?

What is its nature and its purpose?

What is the anterior part of the sclerotic called? Its nature?

What is the nature and structure of second coat?

What forms the third coat?

Where does the optic nerve enter the eye?

How thick is the retina?

What is its microscopic structure?

What is the object of the rods and cones?

Where are they most numerous?

What is the *lutea macula* or yellow spot?

What lies behind the cornea?

What is the nature of the aqueous humor?

What is the irish; were is it?

What is it structure; its purpose?

How is it made to contract?

What and where are the cillary processes?

What is the opening in the iris called; shape and use?

What lies behind the iris?

How many chambers in eye?

What is the nature of the crystalline lens; purpose; shape?

Is it more convex anteriorly or posteriorly?

Where is the vitreous humor; nature and object?

How many refracting media in the eye?

Do they all bend the rays of light in the same direction?

When light enters the eye from an object, what is formed on the retina?

Is this image erect or invert? Why inverted?

How can it be proven it is inverted? *Ans.* Can be seen in the eye of white rabbit and in other eyes.

Why do we then see objects erect?

What is the blind spot of the eye; location?

What is nature of vision at macula lutea?

What shape of crystalline lens causes near-sightedness?

What shape of the eye-ball will cause the same disease?

What kind of glasses will remedy this disease; how?

Does the shape of the lens change with increasing age?

What disease does a flattened eye or lens produce?

What kind of glasses are then used?

Should young children wear glasses? *Ans.* Yes, if needed.

Can one see if the crystalline lense be removed?

Why do the eyes so often suffer from "sympathy"?

How is the stereoscopic effect produce in vision?

Is vision with one eye different from that with two; how?

What is peculiar in the eye of an albino?

What is the lowest form of the eye? *Ans.* Simple bright pigment spots, seen in some very low forms of life.

What peculiarities in eye of fish?

What is peculiar in the eye of the Mongolian?

What is peculiar in the eye of birds?

What is said of the range of a bird's vision?

How is the eye of the bird so quickly focused?

What is peculiar in the eye of a cat?

What is peculiar in eye of insects?

What in the eye of the lobster and crawfish?

What is peculiar in the eye of ruminating animals?

What is the duration of a visual impression?

What is color blindness?

What effect has pressure on the eye?

What is spherical aberration?

What is chromatic aberration?

What are Purkinje's figures?

Is the eye of man a perfect instrument? *Ans.* Perfect in its adaptations to use.

How can the strength of the eye be preserved?

Appendages of the Eye.

What bony shield or protection has the eye?

What is the object of the eyebrows; of eyelashes?

Where are the lachrymal glands; purpose?
Where do the tears leave the eye; where do they go?
What is the object of winking?
How do the eyelids come together in winking?
What is the object of this arrangement?
What is the lining membrane of eyelids called?
What glands along the margins of the lids?
What is the nature and object of their secretion?
What follows paralysis of the eyelids?
What animals have no eyelids?
How many muscles act upon the eyeball?
How many of these are straight; oblique?
What very peculiar arrangement in the superior oblique?
How many muscles in the eye of the ox?
What nerves supply motion impulse to these muscles?
What is squinting or strabismus, and how cured?

Hearing.

What is the organ of hearing?
Into what parts is it divided?
What is the structure of the external ear; object?
What is the shape and length of the meatus?
What and where is the tympanum; tympanum membrane?
If the membrane is punctured is hearing lost?
What is its shape and structure; purpose?
What is understood by the middle ear?
What external communications has it?
What and where is the eustachian tube; object?
In what bone is the internal ear situated?
What is the particular nature of this bone?
Into what parts is the internal ear divided?
What and where is the vestibule?

What are the semicircular canals; how many?
What particular relations do they bear to each other?
What do they contain; their functions?
Which of the cranial nerves goes to the ear?
Is any of it distributed to the semi-circular canals?
What and where is the cochlea; how filled?
How are the nerve fibers arranged in the cochlea?
What are the otoliths; fibers of corti?
How are the vibrations of the tympanum conveyed to internal ear?
How many bones in the ear?
What are their names and shapes?
What sets the tympanum membrane vibrating?
Has the internal ear any opening to exterior?
What is the object of the bony cells behind the ear?
In what direction does the external ear turn in beasts of flight?
In what direction does it turn in beasts of prey?
How do they turn in the horse and mule?
Why cannot man wag his ears?
What animals have no external ear?
Have fishes any ears?
Where are the ears in insects?
What is observed of hearing in the blind?
What causes "hard of hearing"?
How is the tympanum membrane kept pliant?
How can insects be removed from the ear?
How far can an insect enter the head through the ear?

The Voice.

What is the voice? What is speech?
Is voice possessed by fishes; insects; birds?
What is the organ of voice in man? Its shape?

What is the larynx; position; shape; structure?

What is the glottis? The epiglottis? The œsophagus?

What is the *Pomum Adami?*

What and where are the vocal cords?

How do they produce sound? Their number?

What organs modify the voice in forming speech?

What is a falsetto voice? A nasal voice?

What change occurs in the voice of boys? Explain it?

Does this change occur in girls?

Why is pitch higher in the female than in the male voice?

What is the range of the human voice?

What is *quality* in voice? What character?

What is *purity* of voice?

What is whispering? How produced?

What is whistling? Sighing?

What is groaning? Laughing?

Is there such a thing as tongueless speech?

Is there any relation between speech and hearing?

What is ventriloquism?

What is stammering? The cause and cure?

What are vowel sounds? Consonant sounds?

Is the voice capable of development?

How is loudness produced?

How are these organs kept in health?

The Ages of Man.

Name and describe the ages of man.

Name and describe the principal temperaments.

Name natural differences between individuals of human race.

Name acquired differences.

What is heredity; variability; atavasm?

What is the average duration of human life; is this fixed, decreasing or increasing?

What bad effects are produced by modern civilization upon the physical condition of the race?

What is meant by the preservation of the weak and feeble; "Survival of the fittest"?

What is the general effect of commingling of races?

What is the effect of civilization on savage and barbarous peoples?

Disease and Death.

Define disease.

What ideas were held in the past concerning disease?

Can any diseases be controlled and prevented? How?

For what is medicine valuable?

What are some of the errors held concerning medicine?

How should a physician be selected?

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